24. On Longevity and Relative Viability in Mammals and Birds; with a Note on the Theory of Longevity.

By P. CHALMERS MITCHELL, M.A., D.Sc., LL.D., F.R.S., Secretary to the Zoological Society of London.

[Received February 6, 1911: Read March 7, 1911.]

CONTENTS.

Introduction .... p. 425.
Mammalia (8110 examples)... p. 429.
Quadrumana (3084 „)... p. 429.
Summary of Quadrumana ...... p. 435.
Carnivora (1741 examples)... p. 436.
Summary of Carnivora .... p. 443.
Insectivora (67 examples)... p. 444.
Chiroptera (92 „)... p. 444.
Rodentia (1330 „)... p. 445.
Summary of Rodentia............ p. 451.
Hyraces (12 examples)... p. 452.
Proboscidea (4 „)... p. 452.
Ungulata (1035 „)... p. 453.
Perissodactyla (46 „)... p. 453.
Summary of Perissodactyla ... p. 454.
Artiodactyla (989 examples)... p. 454.
Summary of Artiodactyla...... p. 461.
Cetacea & Sirenia.................. p. 462.
Edentata (123 examples) ...... p. 462.
Summary of Edentata............ p. 463.
Marsupialia (618 examples) ... p. 464.
Summary of Marsupialia ...... p. 467.
Monotremata (4 examples) ... p. 467.
Summary of Mammalia .... p. 467.
Aves (12,977 examples) ... p. 470.
Passeres (3224 „)...... p. 470.
Summary of Passeres .... p. 485.
Picariæ (455 examples) .... p. 487.
Summary of Picariæ .... p. 491.
Striges (432 examples) .... p. 492.
Summary of Striges............... p. 493.
Psittaci (1479 examples)......... p. 494.
Summary of Psittaci .... p. 500.
Accipitres (893 examples) ...... p. 501.
Summary of Accipitres .... p. 505.
Steganopodes (165 examples)... p. 506.
Summary of Steganopodes...... p. 507.
Herodiones (480 examples)...... p. 508.
Summary of Herodiones......... p. 510.
Odontoglossæ (23 examples) ... p. 511.
Palamedeæ (22 examples) ...... p. 511.
Anseres (1545 examples)......... p. 512.
Summary of Anseres .... p. 515.
Columbæ (932 examples) ...... p. 516.
Summary of Columbæ............ p. 519.
Pterocletes (83 examples) ...... p. 519.
Gallinæ (1660 examples)......... p. 520.
Summary of Gallinæ .... p. 523.
Hemipodii (15 examples) ...... p. 524.
Fulicariæ (214 examples) ...... p. 525.
Summary of Fulicariæ .... p. 526.
Alectorides (221 examples)...... p. 526.
Summary of Alectorides......... p. 528.
Limicolæ (393 examples)......... p. 529.
Summary of Limicolæ............ p. 530.
Gaviæ (241 examples)............ p. 530.
Summary of Gaviæ .... p. 531.
Tubinares (10 examples)......... p. 531.
Pygopodes (86 examples) ...... p. 532.
Impennes (62 examples) .... p. 532.
Crypturi (146 examples) .... p. 533.
Apteryges (22 examples) ...... p. 533.
Casuarii (77 examples)............ p. 534.
Struthiones (97 examples) ...... p. 535.
Summary of Aves.................. p. 535.
General Summary and Conclusions .... p. 540.
Note on the Theory of Longevity .... p. 545.

INTRODUCTION.

Animals are mortal, and we know that death comes to them after durations of life that differ much in different individuals and species. Unfortunately, except in the rarest cases, it is impossible to obtain information as to the duration of life in wild animals. Enquiry into the frequency of death in domesticated animals, or in animals in captivity, is therefore of scientific and practical interest. From the scientific point of view, it is the only mode of getting any kind of information as to constitutional differences in longevity and viability. From the practical point of view, it is the only way of judging of the effect on duration of life of the different kinds of environment to which animals may be subjected. There exists as yet very little recorded information, and I hope that this memoir may at least stimulate enquiry and make possible the collection and comparison of data.

The normal annual death-rate of the human inhabitants of London is about 14 or 15 per thousand, or 1·5 per cent. per annum, that is to say for every two hundred inhabitants there are about three deaths in the year. There is no census of the sparrow population of London, but the numbers of these hardy birds do not appear to increase or decrease in any marked way. Now a pair of sparrows may rear two or three clutches in the course of the year, each clutch having five or six eggs. If every pair of sparrows alive in London at the beginning of the breeding-season displayed maximum fertility, a death-rate of about 90 per cent. per annum would be necessary to keep the sparrow population stationary. No doubt many sparrows fail to mate successfully, but, judging from the numbers of young birds, it seems highly probable that the annual produce is a least a hundred per cent., which implies a normal death-rate, in a stationary population, of at least 50 per cent. On January 1, 1910, the number of vertebrate animals in our Gardens was 3186, and during the year, 2354 were added to the collection, making a total population of 5540. In the same period there were 1554 deaths, that is to say, the death-rate was about 28 per cent. Here, then, are three widely different rates, an actual percentage of 1·5 in the case of human beings, an estimated percentage of 50 in sparrows, and an observed percentage of 28 in the assemblage of vertebrates in the London Zoological Gardens. It is plain that the rates are not comparable; two of them refer to particular species, the third is a composite made up from many different species of mammals, birds, reptiles, batrachians, and fishes, each with their own different rates. The composite percentage is an arithmetical figure as meaningless as would be the sum of so many cows, coins and cabbages. Even in the case of a single species, however, a generalized death-rate is complex and misleading. The human death-rate is nearly 20 per cent. in the first year of life, falls rapidly for the first two or three years, and then more slowly till it reaches a minimum, and then gradually rises as advanced age is reached. The tables of "expectation of life," calculated for the Life Assurance Companies, show that the male infant under a year old has an expectation of 41 years, that this expectation rises to a maximum of 51 in the fourth year, and then gradually and almost without irregularity decreases until the age of one hundred years has been attained. It is clear that in the case of the vast majority of animals, and notably in the case of wild animals that have been captured and brought into captivity, we have but vague materials for the construction of tables of expectation of life or for attaching any value to death-rates. We know roughly that there is an infantile period of low viability from the close of which through the periods of youth, maturity and senescence, there is a gradually decreasing expectation of life. But there are very few cases in which the durations of these periods or the potential duration of the whole life are known accurately, and still fewer cases in which the position of any single individual on its cycle of life can be determined accurately by physical signs, at least in the living animal. At present there is not enough knowledge on these matters to render possible the construction of any standards against which particular cases could be measured.

Fortunately there remains a mode of estimating the durations of life in a collection of animals which affords some indications of the total effect of the environment on the duration of life. In 1870 Sir Ray Lankester * (whose intellectual acumen has unravelled so many tangles in biology) drew some important distinctions in the significance of the word longevity. Strictly speaking, longevity denotes the duration of life of an individual ; in practice, the word connotes some idea of relatively long duration and is used to indicate the duration of a life that has extended to its natural limit. A further distinction is necessary. The natural limit to the longevity of the individuals of a species may be taken to mean the average age attained by the normal members of a species living under the conditions to which they have become adapted by nature. The specific longevity would be the expectation of life at birth of a normal individual of the species. It is determined partly by the constitution, but still more by the accidents, enemies, diseases, and other external conditions to which the members of the species are naturally subject in every stage of their existence, and it is modified by the powers of evasion, protection, and resistance which they have acquired. On the other hand, it is possible to suppose that a member of a species, by good fortune or by artificial interference, has been removed from the hardships natural to its lot, and placed in an environment relatively ideal ; under such conditions it would survive the specific longevity and attain an age which Lankester called the potential longevity. If we regard the population of Great Britain as living in an environment to which it has been naturally adapted, and the inhabitants of Great Britain as representing a species, then their specific longevity, the expectation of life at birth, is somewhere about 50 years. What the potential longevity is we do not know, but it is certainly more than a hundred years. The disparity is probably much greater in other cases. In the case of the sparrow the specific longevity, the expectation of life

---

* On Comparative Longevity in Man and the Lower Animals : London, 1870.

of the young sparrow when it is hatched, on the most favourable estimate cannot be more than one or two years; the potential longevity of small Passerine birds is certainly over 20 years.

The difference between the specific longevity and the potential longevity is a rough measure of the severity of the natural conditions under which a species lives, and a similar mode of comparison can be applied to assemblages of creatures living under different kinds of unnatural conditions. The object of this communication is in the first place to suggest a fashion in which a system of this kind could be employed usefully in Zoological Gardens, and in the second place to give the results of examination of a series of records regarding the duration of life of mammals and birds in captivity, which, although they are imperfect in many respects, are more extensive than any with which I am acquainted. The records in question are contained in two manuscript folios, kept in the Prosectorium of this Society and covering the period from 1870 to 1902. In these were entered day by day the names of the animals that had died in the Gardens, with the dates of their arrival and of their departure. From the point of view of estimating the effects of captivity on duration of life, they are defective in two important respects. In the first place, there is no record of the ages of the animals on arrival. This of course must always be impossible in the vast majority of cases, but two stages, the infantile and the senile, ought to be noted and excluded, where possible. Of these, the senile stage is usually easy to detect in the case of mammals, and it is at least probable that senile mammals are seldom purchased or accepted. On the other hand, senility in birds is extraordinarily difficult to detect, and the presence of such individuals will probably always confuse the record. The infantile period, corresponding to the first four years of human life, but of course varying greatly in its duration in different animals, is easy to detect; and as the difficulties of rearing infants are entirely different from the general problems of animals in captivity, infants should be excluded from records such as those with which I am dealing. In a number of cases, but not in all, I have been able to discard "infantile" entries. The second important defect in the statistics is that they do not include any note of the condition of the animals on arrival. Owing to the mode of capture, and still more to the conditions of transport, a large number of wild animals arrive at Zoological Gardens in poor condition, and die from causes not due to their new environment. For the kind of investigation I am now discussing (as of course for other reasons) new arrivals ought to be kept in quarantine. The duration of the quarantine need not be for a fixed period, but should be long enough to make certain that there has been recovery from the effects of capture and transport, and the date of detention in the Gardens should begin with that of liberation from quarantine.

With these comments I shall now pass to examination of the records, which however imperfect afford a considerable body of information *.

MAMMALIA †.

QUADRUMANA.

Family SIMIIDÆ.	Number of Individuals.	Average duration, in months.	Maximum duration, in months.
Anthropopithecus troglodytes (Chimpanzee).	20	8	46
A. calvus	2	61	94
A. gorilla (Gorilla)	2	3·5	5
Simia satyrus (Orang)	20	5·5	21
Hylobates (Gibbon), whole genus	39	9	51
H. hoolock	9	17	51
H. lar	16	4·5	12
H. agilis	2	5·5	9
H. leuciscus	6	9·1	29
H. leucogenys	1	7	7
H. muelleri	2	2·5	4
H. pileatus	1	6	6
H. syndactylus	1	9	9
H. hainanus	1	13	13

We know that the figures in the third column are very much below the potential longevities of these animals, whilst the differences between the second and third columns are equally notable. It cannot be doubted that the conditions during the period in question were unfavourable to anthropoid apes. In 1901, after the period to which these figures relate, the existing house for Anthropoid Apes was completed. The new conditions differed from the old in providing more space, better ventilation, and protection from improper feeding by the public. These changes have been beneficial; in the case of the chimpanzee, of the orang and of the gibbon, there is at present alive in the Gardens at least one individual that has lived longer with us than the longest-liver of the previous period. On the other hand, the average duration has not risen notably. These animals must be regarded as of relatively low viability, a conclusion perhaps less surprising if it be remembered that the lower races of man are of lower viability than the civilized races. None the less, existing results are so bad, that drastic experiments would be justified. The simplest change would be to allow them free access to the open air.

---

* Since this paper was written I have seen the extremely interesting "List of Animals," living in the Zoological Gardens at Giza, near Cairo, 2nd Edition, and published in 1910. The author, Capt. Stanley S. Flower, has made the useful innovation of inserting opposite each species a note of the maximum ascertained length of life of an individual specimen in the Gardens. I have added to my paper some of Capt. Flower's records, but as these cover a period of only 12 years, higher maximums were impossible; if be were to publish average durations and state the general conditions of captivity of the different species, the work would be invaluable.

† The names used in this memoir, as far as possible, are those employed in the ninth edition of the "List of Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London"; I have used Trouessart for determining synonyms.

CERCOPITHECIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Semnopithecus, whole genus	56	4·3	15
S. entellus (Langur)	20	4·6	13
S. cephalopterus	24	3·6	15
S. fasciatus	1	2	2
S. maurus	8	4	15
S. obscurus	2	12·5	14
S. hypoleucus	1	3	3

Here again it is plain that the conditions are hostile, and that these monkeys have a low viability. In the natural condition they feed chiefly on grain, and green leaves and shoots, and it is probable that their diet in captivity is not sufficiently bulky in proportion to its nutritive value. But these monkeys have always been treated as requiring warmth rather than fresh air.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Colobus, various species, chiefly *vellerosus*	10	3·2	13

The African Colobus and Guereza monkeys resemble the Asiatic Semnopitheci in structure and habits. They appear equally to suffer from the conditions of captivity.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cercopithecus,* whole genus	693	11·5	122
C. diana	42	13	45
C. neglectus	1	40	40
C. leucampyx	19	9	44
C. nictitans	17	8	30
C. martini	13	22	122
C. labiatus	1	17	17
C. stairsi	4	8	12
C. albogularis	45	11	46
C. grayi	6	12	41
C. mona	28	17	65
C. campbelli	27	12·9	76
C. l'hoesti	1	44	44
C. petaurista	39	11·7	66
C. ascanias	2	7	11
C. schmidti	2	3	5
C. cephus	37	17·7	65
C. erythrotis	2	33·5	47

---

* In this genus, I have followed as nearly as possible the synonymy in Mr. R. I. Pocock's revision, P. Z. S. 1907, p. 677.

CERCOPITHECIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cercopithecus sabæus (= *callitrichus*)	109	7	43
C. æthiops (= *griseo-viridis*)	24	14	60
C. cynosurus	59	13	87
C. tantalus	5	15	37
C. pygerythrus (= *lalandii*)	146	8·6	59
C. talapoin	15	13·8	34
C. patas	40	6·9	27
C. pyrrhonotus	9	5·5	16
Cercocebus, whole genus (Mangabey.)	85	12·2	48
C. æthiops	15	7·5	48
C. albigena	15	10·3	42
C. aterrimus	1	5	5
C. collaris	15	12	38
C. chrysogaster	1	12	12
C. fuliginosus	36	16	40
C. hagenbecki	2	8	10

The Cercopitheques and Mangabeys for the very large number of individuals recorded thus show an average duration of about one year; the best record, about ten years, must be taken as far below the potential longevity of the group, and it is clear that the conditions of captivity press hardly on them. Throughout the period in question, they were treated as animals which must be protected against cold, and they were allowed no access to the open air.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Macacus, whole genus (Macaques.)	910	14	143
M. assamensis	1	5	5
M. brunneus	5	12·8	22
M. cyclopis	2	20	26
M. cynomolgus	328	16·5	130
M. lasiotus	3	28·6	41
M. leoninus	7	18	27
M. nemestrinus	58	20	62
M. pelops	3	10	16
M. pileatus	21	10	27
M. rhesus	212	16·6	143
M. tcheliensis	3	5·3	7
M. silenus	16	30	119
M. sinicus	203	13	75
M. speciosus	4	41	104
M. maurus	7	18	73
M. arctoides	2	16·5	19
M. rufescens	2	8	15
M. ocreatus	9	11	28
M. inuus	24	12·3	38

The large number of Macaque monkeys recorded shows the same low average duration, and the same marked difference between the average and the maximum duration, although the latter is certainly below the potential longevity. A Common Macaque occasionally deposited temporarily at the Gardens is stated by its owner to be at least 22 years old. It is of significance that the highest average relates to Japanese apes, examples of which, unlike all the others, were housed in a cage exposed to the open air.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cynopithecus niger .... (Celebes Black Ape.)	9	10	41
All Baboons	137	12·2	113
Theropithecus gelada	2	9·5	10
Cynocephalus anubis	12	12·6	51
C. babouin	19	10	113
C. doguera	1	4	4
C. hamadryas	22	12	29
C. ibeanus	1	1	1
C. leucophæus	6	16	26
C. mormon	7	15	25
C. neumanni	1	7	7
C. papio	2	3	6
C. porcarius..........................	43	12	50
C. sphinx.............................	21	15	41

Baboons, on the average, show even a lower duration and a greater difference between the average and the potential longevities than Macaques. Since the period in question, a number of baboons have been exposed to the air and the average duration is notably higher.

CEBIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Chrysothrix sciurea .... (Squirrel Monkey.)	44	9	108
Cebus, whole genus .... (Capuchins.)	226	10	50
C. albifrons..........................	33	8·6	20
C. apella	10	11·8	27
C. azaræ	2	11	16
C. capucinus	39	7·5	20
C. fatuellus	58	11·8	50
C. flavescens	6	8·5	12
C. hypoleucus	46	8	17
C. lunatus	9	17	39
C. monachus	21	14·3	42
C. vellerosus.........................	1	15	15
C. versicolor	1	31	31

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Ateles, whole genus (Spider-monkeys.)	107	5·8	27
A. ater	54	4·5	27
A. geoffroyi	10	7·9	24
A. grisescens	1	2	2
A. hybridus	1	9	9
A. melanochir	31	8	20
A. paniscus	4	5·2	10
A. rufiventris	2	3	4
A. variegatus	3	4·6	11
A. vellerosus	1	3	3
Lagothrix humboldti	14	5·2	16
Nyctipithecus, whole genus (Douroucoulis.)	27	13	45
N. felinus	14	13	45
N. rufipes	1	1	1
N. trivirgatus	2	5	5
N. vociferans	10	15 5	28
Callithrix, whole genus (Teetees.)	5	4	8
Pithecia, whole genus	16	2·7	7
Ouacaria, whole genus	7	3·5	11
Mycetes, whole genus	9	3·6	13

The Cebidæ show the same marked disparity between the average duration and the maximum duration, although again the latter must be considerably less than the potential longevity. It is interesting to notice that the Capuchins and Squirrel Monkeys display a higher viability than the others.

Hapalidæ. (Marmosets.)	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hapale, whole genus	232	3·8	16
H. chrysoleucos	1	7	7
H. jacchus	134	4·2	16
H. melanura	1	6	6
H. penicillata	94	3·4	16
H. pygmæa	2	2·5	5
Midas, whole genus	103	6	110
M. chrysomelas	2	6·5	11
M. geoffroii	7	2·4	4
M. labiatus	1	4	4
M. mystax	1	5	5
M. œdipus	25	4	14
M. rosalia	39	9	110
M. rufimanus	11	4·5	16
M. ursulus	17	4·6	12

Amongst the numerous Marmosets dealt with in the record, a single case of relatively high longevity, that of a Lion Marmoset which lived in the Gardens for over 9 years, has given those of the genus *Midas* an average duration of nearly double that of the representatives of *Hapale*. Even this fortunate instance, however, does not disguise the low viability of Marmosets under the conditions of their captivity. As these animals spend a large part of their time in their sleeping boxes, unwise feeding by visitors cannot account for much. On the other hand, they have been treated as animals that required special protection from cold and fresh air.

Miss C. Morey informs me that she has kept a marmoset for 16 years; it was allowed great freedom and had constant access to fresh air.

LEMURES.

LEMURIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Lemur, whole genus	155	25·3	134
L. albifrons	16	43·6	113
L. albimanus	1	36	36
L. brunneus	22	25	98
L. catta	33	19	38
L. coronatus	10	19·5	55
L. flavifrons	1	45	45
L. macaco	17	46	134
L. mayottensis	1	2	2
L. mongoz	7	39	122
L. niger	3	63	107
L. nigerrimus	2	30·5	43
L. nigrifrons	3	23	46
L. rufifrons	13	27	113
L. rufipes	3	22	29
L. varius	10	20·9	77
L. xanthomystax	13	29	72
Hapalemur simus	2	5·5	8
H. griseus	6	22	58
Chirogaleus coquereli	8	82	184
C. milii	2	70	138
Microcebus smithi	14	20	84
Galago, whole genus	61	22	86
G. alleni	3	9	15
G. crassicaudata	7	16	34
G. garnetti	20	17·5	43
G. maholi	25	26·7	78
G. monteiri	6	32	86
Nycticebus javanicus	1	21	21
N. tardigradus	29	13	49
Loris gracilis	12	3·4	7
Perodicticus potto	18	9·3	22
Chiromys madagascariensis	3	36·3	107

With the exception of the Loris and the Potto, the Lemurs show a longer average duration and a higher maximum duration than in the case of Monkeys. There still remains, however, a very marked discrepancy between the average duration and the maximum duration, although the latter must be regarded as much below the probable potential longevity. On the whole, lemurs have been kept under conditions not very different from those of the monkeys. It is probably in their favour that as they are more nocturnal than monkeys, they have escaped to a greater extent erroneous feeding by the public, whilst as they are on the whole more strictly arboreal than monkeys, the relative absence of light and the more equable temperature in the interior of warmed houses have not been so damaging to them. On the other hand, they are, on the average, smaller than monkeys, and as within the same group smaller animals have usually shorter lives than larger animals, a longer average duration and a higher maximum duration as compared with monkeys, was not to be expected.

Summary of Quadrumana.

It is well known that the higher races of men have a higher viability than the lower races; that is to say, they display a greater power of resistance to adverse conditions, to changed conditions, and to diseases (although not necessarily to any particular disease). It is of interest to find that a still lower viability is exhibited by apes and monkeys which as a group have an amazingly poor power of resistance to the adverse conditions of captivity. It is even more interesting to note that there is a marked gap between monkeys and lemurs in this respect. The fact that the latter on an average live four or five times as long in captivity as monkeys, shows a marked difference in their constitutions. I may recall a curious by-product of an investigation into the feeding of snakes made by my friend and colleague Mr. R. I. Pocock and myself (P. Z. S. 1907, p. 785), when we found that lemurs differed from monkeys in having no fear of snakes. Fundamental differences between groups are revealed not only by anatomical characters, and in view of the present tendency to lay increasing stress on the anatomical links between lemurs and other primates, I think their physiological differences are worth some attention. There is, however, another interpretation of the higher viability of lemurs in captivity. The close affinity of man and monkeys may render the latter more subject to human diseases and therefore more liable to suffer from the vicinity of man. Such a question can be answered only by long records of the causes of mortality based on adequate diagnosis. The laborious work of my friend and colleague Mr. H. G. Plimmer, unfortunately does not extend back to the period with which my present inquiry deals.

Even if it be accepted that apes, monkeys, and lemurs are creatures of inherently low powers of resistance, the striking difference between the average durations and the maximum durations makes it clear that they have been subjected to adverse conditions. Throughout the period to which the figures relate, and in a majority of cases since, the conditions of their housing have been determined by considerations of temperature rather than of fresh air. The conclusion is inevitable that these conditions are adverse. This is not the place to discuss the construction of houses for animals, but it may be well to say that there is no reason to suppose that the other extreme, complete indifference to the provision of warmth, would be much better, although it could not be much worse.

Capt. Stanley Flower's records show no figures of maximum duration greater than those recorded here.

CARNIVORA.

FELIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Felis leo (Lion)	53	45·4	204
F. tigris (Tiger)	30	44·2	145
F. pardus (Leopard)	52	39·9	164
F. uncia (Snow-leopard)	2	20·5	40
F. lynx (Lynx)	8	57	169
F. rufa (Bay Lynx)	3	55	122
F. canadensis (Canadian Lynx)	2	73	139
F. caracal (Caracal)	9	63	131
F. concolor (Puma)	18	41·2	124
F. onca (Jaguar)	8	33·5	123

I have omitted from these figures a certain number of entries of under one month and which, in most cases, related to very young animals or new-born cubs. The highest record in the period, 17 years, in the case of a Lion, is certainly very much under the potential longevity of the group, for lions of between 30 and 40 years old have been known. The discrepancy between the average duration and the maximum duration is still great, but very much less serious than in the case of apes and monkeys, and considerably less than in the case of lemurs. Capt. Stanley Flower gives no higher records.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
F. nebulosa (Clouded Tiger)	1	62	62
F. serval (Serval)	22	21·7	98
F. servalina (Servaline Cat)	5	9	45
F. temmincki (Golden Cat)	4	24	65
F. viverrina (Viverrine Cat)	4	51	112
F. bengalensis (Bengalese Cat)	22	16	77
F. planiceps (Rusty Tiger Cat)	2	5	5
F. rubiginosa (Rusty Spotted Cat)	2	1·5	2
F. chrysothrix (Red Tiger Cat)	1	1	1
F. catus (Wild Cat)	31	15	110
F. chaus (Jungle Cat)	15	47	118

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Felis caffra (Kaffer Cat)	3	1	2
F. maniculata (Fettered Cat)	2	17·5	35
F. yaguarundi (Yaguarundi Cat)...	5	1	3
F. eyra (Eyra Cat).....................	10	19	109
F. pardalis (Ocelot)	56	17	152
F. tigrina (Tigrine Cat)	4	3	5
F. geoffroii (Geoffroy's Cat)	10	17·8	103
F. passerum (Pampas Cat)	2	8	10

The records of average and maximum duration of these smaller Cats are very irregular, and in many cases the numbers are too small for the result to be more than accidental. We do not know what is the potential longevity of the smaller cats; it may be expected to be less than that of large cats, and has been estimated at something over twenty years. It is clear that the difference between average duration and potential duration has been much greater in the case of the small cats than in that of the large cats. The domestic cat is notoriously a hardy animal, and I should hesitate to infer a lower viability for small cats than for large cats. In the first place, throughout the period under discussion, the majority of the large cats were kept in the Lion House, a building in which the ventilation and bulk of air per inhabitant were fairly good, whilst, although there was not free communication with the outer air, there were outdoor cages, to which on occasion the animals had access. The smaller cats, on the other hand, were kept in a smaller and darker house, with much less ventilation, more heating, and no access to the open air. In the second place, there is an important natural difference with regard to feeding, which has not been allowed for systematically. The larger cats are accustomed to make an occasional kill, and to return to a carcase even after it is putrid. The smaller cats, on the other hand, devour their smaller prey as soon as they have killed it, and unless under the pressure of serious hunger, take nothing except quite fresh food. In accordance with their natural habits, the larger cats are little injured by food which is not quite fresh, whilst the smaller forms are highly susceptible to intestinal ailments arising from the quality of their food. I am convinced that the necessity for extreme care in the quality of food given to the smaller cats has not been sufficiently realized.

I do not think there can be any doubt, however, that both with smaller and larger Felidæ, the necessity of access to the open air, at the choice of the animals, has not been appreciated, and that the low viability under menagerie conditions is due to this neglect. Most of them are partly nocturnal, many of them cover a wide climatic range, and as in many, if not all furred animals, the thickness and length of their coat increase rapidly with exposure to low temperatures. No doubt provision for basking in the sun, or for warming themselves in artificially-heated retreats, is necessary in most cases, but even more necessary is constant access to the open air, by night and by day, at the free choice of the animals.

FELIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cynælurus jubatus (Cheetah)	17	30	78
Cryptoprocta ferox (Cryptoprocta) ...	2	4·5	5

Capt. Stanley Flower records a duration of over 9 years for a Cheetah, the animal being still alive.

VIVERRIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Viverra, whole genus	19	65	181
V. civetta (African Civet)	14	66	181
V. tangalunga (Sumatran Civet)	4	40	81
V. zibetha (Large Indian Civet)	1	143	143
Viverricula, whole genus	12	33·5	93
V. malaccensis (Indian Civet)	11	34·5	93
V. schlegeli (Schlegel's Civet)	1	23	23

We have no information as to the potential longevity of Civets, but the record of 15 years is no doubt considerably too short. On the other hand, their average duration of life has been good; it is interesting to notice that, although these are at least as typically tropical animals as the majority of the Felidæ, they have been for the most part kept out of doors in unwarmed shelters.

Genetta, whole genus	46	30	148
G. felina (Feline Genet)	2	16	16
G. pardina (Pardine Genet)	4	47·5	148
G. senegalensis (Pale Genet)	4	8	17
G. tigrina (Blotched Genet)	22	35	122
G. vulgaris (Common Genet)	14	27	101
Paradoxurus, whole genus	58	35	185
P. aureus (Golden Paradoxure)	3	16	35
P. grayi (Gray's Paradoxure)	3	55	99
P. niger (*P. prehensilis*, *P. pallasi*, *P. hermaphroditus*) (Common Paradoxure).	35	25·8	111
P. larvatus (Masked Paradoxure)......	8	64	185
P. leucomystax (White-whiskered Paradoxure).	4	53	166
P. philippensis (Philippine Paradoxure)	5	28	102
Arctogale leucotis (Three-striped Paradoxure).	8	40	132
A. trivirgata	1	5	5
Hemigalea hardwickii (Hardwicke's Hemigale).	2	5·5	7
Arctictis binturong (Binturong)	8	39	82

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Nandinia binotata (Two-spotted Paradoxure).	16	32	85
Galidia elegans (Elegant Galidia)	2	4·5	9
Herpestes, whole genus	152	20·8	105
H. albicauda (White-tailed Ichneumon)	3	31·3	75
H. fulvescens (Maccarthy's ,,)	4	15	20
H. galera (Marsh ,,)	9	31	57
H. gracilis (Slender ,,)	5	17·4	35
H. griseus (Grey ,,)	70	14	53
H. ichneumon (Egyptian ,,)	15	40	91
H. auro-punctatus (Spotted ,,)	30	18	57
H. pulverulentus (Dusty ,,)	7	47	105
H. smithi (Ruddy ,,)	9	22	35
Cynictis penicillata (Levaillant's Cynictis).	18	32	145
Crossarchus obscurus (Kusimanse) ...	5	15·6	49
C. fasciatus (Banded Ichneumon)......	24	32·8	92
Suricata tetradactyla (Suricate).........	45	12·6	58

The Genets, Paradoxures, Ichneumons, and Suricates are small carnivores varying in their diet from purely carnivorous (including small mammals, birds, reptiles, eggs, insects) to a mixed and partly frugivorous or vegetarian type. What their potential longevity may be is quite unknown, but the records of maximum duration going to over fifteen years are unexpectedly high for these small animals. The average duration varies very much, but is lower than in the case of the civets. During the period covered by the records, the genets, paradoxures, etc., unlike the civets, have been kept in most cases in a warmed house, without access to the open air.

Capt. Stanley Flower has no higher records.

PROTELIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Proteles cristatus (Aard-Wolf)	6	53	155

We have no information as to the potential longevity of this aberrant animal, but it appears to have a high viability.

HYÆNIDÆ.

Hyæna, whole genus	43	29·5	160
H. brunnea (Brown Hyæna)	5	30·2	56
H. crocuta (Spotted ,,)	11	58·7	160
H. striata (Striped ,,)	27	17·6	74

Nothing is known as to the potential longevity of hyænas, and the record of 13 years in the Gardens may possibly be a fair age for these animals. They have been kept at the Gardens in cages under cover, exposed on one side to the open air and provided with hot-water pipes. They have had little room for exercise. The lower viability of the striped species is difficult to explain. Capt. Stanley Flower quotes a Spotted Hyæna and a Striped Hyæna, each with a duration of over 10 years, and still alive.

CANIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Canis lupus (Common Wolf)	18	29	72
C. hodophylax (Japanese ,,)...........	1	90	90
C. pallipes (Indian ,,)...........	5	42	149
C. latrans (Prairie ,,)...........	4	59	115
C. antarcticus (Antarctic ,,)...........	2	41·5	64
C. niger (Black ,,)...........	2	75	90
All Wolves	32	40	149
C. anthus (North-African Jackal)......	36	13·3	82
C. aureus (Common ,,)......	16	22·4	122
C. lateralis (Side-striped ,,)......	8	24	56
C. mesomelas (Black-backed ,,)......	39	19	164
All Jackals	99	18	164
C. dingo (Dingo)........................	11	43	145
C. (Cuon) primævus (Indian Wild Dog)	6	35	55
C. (Cuon) rutilans (Malay Wild Dog) .	4	22	28
C. jubatus ("Maned Wolf")	2	15·5	23
C. azaræ (Azara's Dog)	19	35	103
C. cancrivorus (Crab-eating Dog)	19	15	60
C. magellanicus (Magellanic Dog)......	4	32	100
C. fulvicaudus (Red-tailed Dog)	1	53	53
C. fulvipes (Red-footed Dog)...........	1	16	16
C. (Nyctereutes) procyonoides (Raccoon Dog).	13	26	69
C. microtis (Small-eared Dog)	1	4	4
All fox-like Dogs	58	27	103
C. argentatus (Silver Fox)...............	1	48	48
C. bengalensis (Bengal Fox)	12	21	68
C. cerdo (Fennec Fox)	10	24·9	110
C. chama (Silver-backed Fox)	15	19	62
C. famelicus (Syrian Fennec)	5	14·4	32
C. fulvus (Red Fox)	21	30	97
C. lagopus (Arctic Fox).................	24	48·8	132
C. leucopus (Indian Desert-Fox)	6	50	91
C. niloticus (Egyptian Fox)	9	32·5	77
C. pallidus (Pale Fennec Fox)	5	15	60
C. velox (Kit Fox)	5	34	71
C. virginianus (Virginian Fox).........	11	12·6	30
C. vulpes (Common Fox)	41	14·6	87
All Foxes and Fennec Foxes.........	165	26·7	132
Lycaon pictus (Cape Hunting-Dog) ...	6	19·3	56
Icticyon venaticus (Bush-dog)	1	2·5	4
Otocyon megalotis (Long-eared Fox) ...	4	4·5	8

The potential longevity of Canine animals is probably not much more than thirty years. Ray Lankester * has recorded a domestic dog of 34 years; the oldest Metchnikoff was able to procure was 22 years and was very decrepid. The maximum record in this list—a Jackal which lived in the Gardens for nearly fourteen years, but the age of which on arrival is unrecorded,—is, therefore, not at all unexpected. The viability varies roughly with size, the wolves having a better average than jackals, small wild dogs and foxes. Within the period recorded, so far as I can ascertain, the wolves have been freely exposed to the open air, whilst many, although not all, of the smaller animals have been provided with artificial heat.

Capt. Stanley Flower has no higher records.

MUSTELIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Mustela, whole genus	38	29	123
M. erminea (Common Stoat)	7	21	39
M. foina (Beech-Marten)	5	48·4	84
M. martes (Pine-Marten)	7	27	107
M. pennanti (Canadian Marten)	1	123	123
M. putorius (Pole-cat)	11	10·6	26
M. vulgaris (Weasel)	7	38·7	94
Gulo luscus (Glutton)	6	42	64
Galictis barbara (Tayra)	13	30	95
G. vittata (Grison)	12	41	117
Ictonyx frenata (Banded Zorilla)	1	2	2
I. lybica (Libyan Zorilla)	8	8·5	41
I. zorilla (Cape Zorilla)	18	15	65
Helictis subaurantiaca (Orange-bellied Helictis).	1	48	48
Mellivora capensis (Cape Ratel)	1	208	208
M. indica (Indian Ratel)	1	152	152
Taxidea americana (American Badger)	2	130	145
Meles ankuma (Sand Badger)	3	79	152
M. leptorhynchus (Sharp-nosed Badger)	1	9	9
M. taxus (Common Badger)	26	32	137
All Badgers	32	41·5	152
Mephitis mephitica (Canadian Skunk)	5	25	50
Conepatus mapurito (Chilian Skunk)	5	21	49
Lutra leptonyx (Small-clawed Otter)	2	7	10
L. nair (Indian Otter)	3	32	52
L. vulgaris (Common Otter)	36	40	87

The average and maximum durations of the various Musteline carnivores vary irregularly. The longest duration, 17 years for a Cape Ratel, is surpassed by an Indian Ratel which has been for 20 years in the Gardens and is still alive. It is clear that the potential longevity of the Mustelines is high, if their relatively small size be considered. The apparent low viability of many of these animals may be attributed partly to their fierce and active disposition, from which it comes about that captured animals are frequently young or feeble, and that after capture there is heavy mortality from fighting and injury. But there is a marked effect of the mode of housing; the ratels and badgers have been kept in open-air enclosures, whilst a majority of the other forms have been housed in small cages in dark, warmed and badly-ventilated houses.

---

* Quoted by É. Metchnikoff, 'The Prolongation of Life,' English Translation. Heinemann, London, 1907.

Capt. Stanley Flower has no higher records.

PROCYONIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Procyon cancrivorus (Crab-eating Raccoon).	10	68	190
P. lotor (Raccoon)	24	50	165
Nasua narica (White-nosed Coati) .	35	14	46
N. rufa (Ring-tailed Coati)	63	12·5	62
Cercoleptes caudivolvulus (Kinkajou)	30	30	75
Bassaris astuta (Cunning Bassaris).	5	10·6	29
Bassaricyon alleni (Allen's Bassaricyon).	1	66	66

The Procyonidæ are another group regarding the potential longevity of which we have no information. The record of nearly 16 years for a Raccoon shows that the group in this respect resembles the larger mustelines. It is noteworthy that the average longevity of the Raccoons, which have been kept out of doors, is very much higher than that of the Coatis, which have been kept indoors.

ÆLURIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Ælurus fulgens (Panda)..................	2	32	64
URSIDÆ.			
Ursus, whole genus........................	75	68·9	400
U. americanus (Black Bear)............	12	73	205
U. arctos (Brown ,,)...........	20	23·6	133
U. horribilis (Grizzly ,,)...........	1	164	164
U. isabellinus (Isabelline ,,)...........	4	84	153
U. japonicus (Japanese ,,)...........	2	109·5	123
U. malayanus (Malay ,,)...........	5	91	247
U. maritimus (Polar ,,)...........	8	102	400
U. ornatus (Spectacled ,,)...........	2	96	163
U. piscator (Hairy-eared ,,)...........	1	309	309
U. syriacus (Syrian ,,)...........	8	107·6	259
U. tibetanus (Himalayan ,,)...........	12	39	179
Melursus ursinus (Sloth Bear)	9	41	109

The duration of over 33 years attained by a Polar Bear may possibly approach the potential longevity of bears, for the conditions provided, affording exercise, constant access to fresh air and to shelter, and regular food, must be more natural than in the case of most animals in captivity. The average duration of life of the bears is probably low on account of the number of cubs which are included and which had received unwise treatment as pets. Nevertheless, the average longevity is higher than in the case of any other large carnivora, and it is interesting to notice that during the period dealt with these animals, although not given good room for exercise, were freely exposed to the open air, and at the same time provided with some artificial heat.

Capt. Stanley Flower's records are much lower.

OTARIIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Otaria, whole genus	6	108	210
O. californiana (Californian Sea-lion)	1	51	51
O. hookeri (Hooker's ,,)	2	18	34
O. jubata (Patagonian ,,)	2	199	210
O. pusilla (Cape Sea-lion)	1	151	151
Halichœrus gryphus (Grey Seal)	7	17	73
Phoca vitulina (Common Seal)	25	20	172
Monachus albiventer (Mediterranean Seal).	2	17	34
Cystophora cristata (Bladder-nosed Seal).	7	4·5	26

Sea-lions and Seals evidently at least equal in potential longevity other members of the order Carnivora of large size. The relatively low average duration is due to the very heavy mortality of young and newly caught animals. The greatest number of deaths are of animals that have lived only a few months in the Gardens; if they survive that period, and only a small proportion do survive it, their duration of life is very good. They have free access to open air, and no artificial heat.

Summary of Carnivora.

Carnivora are generally regarded as animals with relatively long lives and high viability, and the records given above support such a view. It is curious, moreover, how the maximum durations correspond roughly with the sizes of the animals. Bears reached 33 years, Lions and Tigers 17, Sea-lions 17, the smaller Cats 13, Viverrids 15, Hyænas 13, Jackals 13, Badgers 12, smaller Dogs and Foxes 10, Mustelines 10. On the other hand, comparison of average durations with maximum durations shows in the clearest way that those animals have lived best which have had the readiest access to fresh air, that, in fact, darkness and the bad air of heated houses are much greater dangers to life than cold.

INSECTIVORA.

SORECIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Crocidura cærulescens (Bluish Shrew) .	1	1	1
ERINACEIDÆ.			
Erinaceus, whole genus	53	10	54
E. albiventris (White-bellied Hedgehog)	1	1	1
E. algirus (Algerian Hedgehog)	3	28	35
E. auritus (Long-eared ,,)	8	12	24
E. collaris (Collared ,,)	6	19	54
E. europæus (European ,,)	33	7	20
E. frontalis (Cape ,,)	1	1	1
E. micropus (Small-footed ,,)	1	1	1
TUPAIIDÆ.			
Tupaia peguana (Peguan Tree-Shrew)	1	22	22
T. tana (Tana Tupaia)	1	28	28
CENTETIDÆ.			
Centetes ecaudatus (Tenrec)	11	10·5	24

I do not know of any information as to the potential longevity of Insectivora, and the few records which I have found would appear to show that both the viability and the longevity of these animals under the conditions of captivity are bad. They have invariably been kept indoors, in small cages in houses heated in winter.

Capt. Stanley Flower's records are all low, the maximum being 34 months for a Long-eared Hedgehog.

CHIROPTERA.

PTEROPODIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pteropus, whole genus	42	30	205
P. formosus (Formosan Fruit-bat) .	3	62	94
P. gouldi (Gouldian ,,) .	1	58	58
P. medius (Indian ,,) .	30	27	205
P. poliocephalus (Australian ,,) .	6	22	83
P. pselaphon (Bonin ,,) .	1	26	26
P. scapulatus (Scapulated ,,) .	1	7	7
Cynonycteris collaris (Collared Fruit-Bat).	13	18	108
Cynopterus marginatus (White-eared Fruit-Bat).	4	24	30

Metchnikoff has already recorded from the London Zoological Gardens the case of maximum duration amounting to 17 years in a Fruit-bat, and has pointed out that the probable maximum longevity of such bats is high. The records show that the viability under existing conditions is not good, as wherever there is a considerable number of specimens, the average duration is much below the maximum duration. There is no difficulty about feeding these animals, but they have always been treated as creatures requiring protection from cold and indifferent to fresh air.

Capt. Stanley Flower records a Collared Fruit-bat of over 11 years' duration and still alive.

VESPERTILIONIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Vespertilio noctula (Great Bat) ...	10	1·9	5
V. nattereri (Natterer's Bat)	12	1	1
Plecotus auritus (Long-eared Bat) .	11	·09	1

Bats are popularly supposed to be long-lived animals, but these records show only the complete failure to keep them in captivity. The chief difficulty has been to induce them to feed.

RODENTIA.

SCIURIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sciurus, whole genus	273	15·5	181
S. æstivans (Tropical Squirrel) ...	2	22·5	41
S. arizonensis (Arizona ,,) ...	1	39	39
S. atrodorsalis (Dark-backed ,,) ...	1	10	10
S. bicolor (Jelerang ,,) ...	4	10·5	23
S. caniceps (Hoary-headed ,,) ...	1	114	114
S. castaneiventris (Chestnut - bellied Squirrel).	2	71	107
S. cinereus (Grey Squirrel)	24	48·7	181
S. ephippium (Saddled ,,)	1	64	64
S. erythropus (White-banded Squirrel)	2	13·5	15
S. griseus (Western Grey ,,)	3	25	40
S. griseo-flavus (Guatemala ,,)	1	34	34
S. hudsonius (Hudson-Bay ,,)	9	40·5	99
S. hypopyrrhus (Dorsal ,,) + *dorsalis*.	20	34·4	89
S. ludovicianus (Yellow-footed ,,)	2	29·5	56
S. macrurus (Grizzled Hill ,,)	2	13·5	19
S. madagascariensis (Madagascar ,,)	1	4	4
S. maximus (Malabar ,,) = *indicus*.	19	21·5	75
S. nigro-vittatus (Malayan ,,)	1	34·5	68
S. palmarum (Palm ,,)	35	3·2	14
S. plantani (Plantain ,,)	15	22	53
S. prevosti (Prevost's ,,)	8	13·5	34
S. pusillus (Dwarf ,,)	2	8·5	12
S. pygerythrus (Blanford's ,,)	1	2	2
S. stramineus (Fraser's ,,)	2	8	8
S. syriacus (Syrian ,,)	3	59	69
S. tennenti (Tennent's ,,)	5	25·4	42
S. tristriatus (Three-striped ,,)	4	3·5	5

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sciurus variabilis (Variable Squirrel)	2	73	75
S. variegatus (Red-bellied ,,)	13	36	129
S. vulgaris (Common ,,)	77	6	20
S. vulpina (Vulpine ,,)	10	36	85
Xerus, whole genus	24	9·8	41
X. erythropus (Red-footed Ground Squirrel).	7	8	19
X. getulus (Getulian Ground Squirrel).	11	10·5	41
X. setosus (Bristly Ground Squirrel).	6	10	15
Tamias, whole genus	16	26	84
T. asiaticus (Asiatic Ground Squirrel)	3	8	23
T. lateralis (Side-striped ,, ,,)	1	21	21
T. striatus (Chipping Squirrel)	12	31	84
Pteromys, whole genus	5	61	163
P. albo-rufus (Red-bellied Flying-Squirrel).	1	163	163
P. inornatus (Large Red Flying-Squirrel).	1	2	2
P. leucogenys (White Cheeked Flying-Squirrel).	1	101	101
P. magnificus (Red-bellied Flying-Squirrel).	1	36	36
P. oral (Large Brown Flying-Squirrel).	1	3	3
Sciuropterus, whole genus	14	15	61
S. fimbriatus (Grey Flying-Squirrel) .	11	13·7	61
S. layardi (Layard's ,, ,,) .	1	1	1
S. volucella (American ,, ,,) . = *volans.*	2	30	37
Spermophilus, whole genus	24	17	132
S. citillus (European Souslik) ...	5	7·4	11
S. grammurus (Line-tailed ,,) ...	1	119	119
S. mexicanus (Mexican ,,) ...	3	47	132
S. mongolicus (Mongolian ,,) ...	4	10·7	22
S. tridecimlineatus (Thirteen-striped Souslik).	11	5·5	22
Arctomys, whole genus	23	64	164
A. caudatus (Long-tailed Marmot) .	1	15	15
A. himalayanus (Himalayan ,,) .	1	79	79
A. hodgsoni (Hodgson's ,,) .	2	73·5	74
A. marmotta (Alpine ,,) .	10	82	164
A. monax (Quebec ,,) .	9	57	116
Cynomys ludovicianus (Prairie ,,) .	48	30	98

I am unacquainted with any published observations as to the longevity of Squirrels and other members of the Sciuridæ, and it was a surprise to find that a Squirrel had lived over fifteen years, a Flying-Squirrel over thirteen, a Souslik eleven, and a Marmot over thirteen. It first occurred to me that as these animals have not an individuality that is very obvious, mistakes with regard to individuals might have confused the records. Such an explanation, however, does not cover the facts; it would apply at least equally well to the Common Squirrel, the 77 examples of which showed no case of great longevity and a very low average, and it could not possibly account for the many cases of high longevity, where only two or three examples are recorded throughout the period of thirty-three years. We must take as established the striking fact that squirrel-like animals have a very high potential longevity in proportion to their size and in comparison with other vegetable-feeding forms, as the latter are on the whole relatively short-lived. The average duration and therefore the viability of the group appears to vary much; some species are almost uniformly unsuccessful, whilst others show a distribution of durations very close round the average. Taking the group as a whole, however, it has shown a relatively high viability just as it has a relatively high maximum longevity. It is particularly interesting to reflect that during the greater part of the period to which the figures relate, most of these squirrels were housed in outdoor cages freely open to the air, with no artificial heating, but with small nesting-boxes as retreats.

CASTORIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Castor fiber (European Beaver) ...	4	4·2	7
C. canadensis (Canadian ,, ...	30	40·3	130

The great difference in viability between European and Canadian Beavers is remarkable. The average of the latter is relatively low on account of the large proportion that lived only a few months; if two or three months were survived these beavers usually lived some years. The number of European beavers within the period is small, and it may well be that it included no healthy, nearly adult individual.

MYOXIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Myoxus, whole genus	23	14·6	35
Myoxus dryas (Oak Dormouse)	6	12·5	30
M. glis (Fat ,,)	3	14·3	34
M. quercinus (Garden ,,)	14	15·5	35
Muscardinus avellanarius (Common Dormouse).	17	3·5	13

The relative low viability of, or failure with, the common English Dormouse is remarkable. A high longevity is not to be anticipated for dormice, although I am unaware of any recorded observations. Throughout the period in question, these animals were kept in a badly ventilated house, usually kept hot.

MURIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hydromys chrysogaster (Golden-bellied Beaver-rat).	6	11	17
Gerbillus, whole genus	179	19	54
G. ægyptius (Lesser Egyptian Gerbille).	39	9	42
G. campestris (Field Gerbille)	2	32·5	36
G. indicus (Indian ,, ...	15	17	32
G. longifrons (Long-fronted Gerbille)	79	18·8	54
G. pygargus (White-rumped ,,)	2	17	28
G. pyramidum (Large Egyptian ,,)	14	14	24
G. robustus (Robust ,,)	2	12	16
G. shawi (Shaw's ,,)	26	18·8	35
Psammomys obesus (Fat Sand-Rat) .	1	17	17
Georychus capensis (Cape Mole-Rat) .	1	11	11
Cricetus frumentarius (Common Hamster).	12	17	27
Cricetomys gambianus (Gambian Pouched Rat).	8	20	33
Mus, whole genus	64	16	50
M. arboricola (Sydney Bush-Rat) ...	3	45	50
M. bandicota (Bandicoot Rat)	2	19·5	21
M. barbarus (Barbary Mouse)	20	19·5	33
M. blanfordi (Blanford's Rat)	3	5	8
M. cervicolor (Fawn-coloured Mouse)	2	13·5	18
M. exulans (Pacific Mouse)	9	3·6	7
M. minutus (Harvest Mouse).........	10	15·5	33
M. rattus (Black Rat)	13	17	41
M. sylvaticus (Long-tailed Field-Mouse).	2	4·5	7
Isomys variegatus (Varied Field-Rat)	7	52	81
Acomys hunteri (Hunter's Spiny Mouse).	11	38·4	53
Arvicola, whole genus	14	8	25
A. agrestis (Short-tailed Vole)......	7	8·3	25
A. amphibius (Water Vole)	5	9	16
A. pratensis (Bank Vole)...............	2	7·5	14
Myodes lemmus (Norwegian Lemming)	5	5	19
Fiber zibethicus (Musquash)	7	14	75

The only published statement regarding the age of mice with which I am acquainted, is Metchnikoff's assignment of "five or six" years as their limit. It may be supposed that the larger forms have a higher potential longevity. The maximum duration in the record is nearly 7 years in the case of an Egyptian Field Rat. Comparatively few of the maxima approach this figure, and the relation between the maximum and average durations is fairly close. As in proportion to their size these rodents have rather a high viability, it must be supposed that the conditions of detention in the interior of a house are not very unfavourable to them.

SPALACIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Rhizomys badius (Bay Bamboo-Rat) .	5	17·4	41

DIPODIDÆ.			
Dipus ægyptius (Egyptian Jerboa) ...	48	18·8	56
D. hirtipes (Hairy-footed Jerboa)...	30	16	36
Dipodillus simoni (Simon's Dwarf Jerboa).	3	20	23
D. campestris (Dwarf Jerboa)	1	12	12
Alactaga indica (Indian Jerboa)	1	14	14
A. decumana (Persian Jerboa)	2	10·5	13

If Jerboas can be compared with rats and mice, the record of nearly five years for an Egyptian Jerboa is what might be expected, but the maxima for most of the species and the average durations show a low viability. The Jerboas have always been kept in a warmed house.

OCTODONTIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Octodon cumingi (Cuming's Octodon) .	35	24	62
Ctenodactylus gundi (Gundi Rat) ...	2	5·5	7
Myopotamus coypu (Coypu)	39	30	121
Capromys brachyurus (Short-tailed Capromys).	3	11	15
C. pilorides (Fournier's Capromys) ...	5	36	116
Aulacodus swindernianus (Ground-Rat).	2	10·5	16

Some of the Octodontidæ are relatively large rodents and the record of 10 years for a Coypu is not surprising. The viability as shewn by the average duration is not high; in the case of the Coypus, which have always been provided with access to the open air, the average duration is lowered by high mortality amongst young born in the Gardens.

HYSTRICIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hystrix, whole genus	34	89	245
H. cristata (Crested Porcupine) ...	26	70·9	245
H. javanica (Javan ,,) ...	6	123	181
H. longicauda (Sumatran ,,) ...	2	137	163
Atherura africana (African Brush-tailed Porcupine).	8	26·3	117
A. fasciculata (Indian Brush-tailed ,,).	2	29	50
Erithizon dorsatus (Canadian Porcupine).	3	18·3	32
Sphingurus, whole genus	18	23	107

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sphingurus insidiosus (Guianan Tree Porcupine).	1	40	40
S. mexicanus (Mexican Tree Porcupine).	1	7	7
S. prehensilis (Brazilian Tree Porcupine.	9	15	47
S. spinosus (Spiny Tree Porcupine) .	1	1	1
S. villosus (Hairy ,, ,,) .	6	40	107

The Porcupines are another set of animals regarding the longevity of which I am unaware of published information, and it is most interesting to find that they attain considerable ages, the record of over twenty years for a common porcupine being remarkable for a relatively small vegetable-feeding animal. The high average duration (over 7 years) of the whole genus *Hystrix* shows that these animals have a high viability. The contrast between the records of maximum and average durations for the genus *Hystrix* and those for other genera is extremely interesting. In the period in question, the species of *Hystrix* have been given free access to the open air and unheated shelters, whilst examples of other genera have been for the most part kept inside artificially heated houses.

Capt. Stanley Flower's record cases are not so high.

CHINCHILLIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Chinchilla lanigera (Chinchilla)	38	30	84
Lagotis cuvieri (Cuvier's Lagotis) ...	1	18	18
Lagostomus trichodactylus (Viscacha)	30	32	81
DASYPROCTIDÆ.			
Cœlogenys paca (Spotted Cavy)	35	22	92
Dasyprocta, whole genus	101	31	109
D. acouchy (Acouchy)	4	33·5	61
D. aguti (Golden Agouti)	20	27·7	101
D. azaræ (Azara's ,,)	3	94	109
D. cristata (West Indian Agouti)	29	27	99
D. isthmica (Central American ,,)	15	31	97
D. mexicana (Mexican ,,)	2	11·5	14
D. prymnolopha (Hairy-rumped ,,)	20	32	108
D. punctata (Punctated ,,)	8	28	84
CAVIIDÆ.			
Dolichotis patachonica (Patagonian Cavy).	18	30	93
Cavia flavidens (Yellow-toothed Cavy).	1	10	10
C. spixi (Spix's Cavy)	4	28	48
Cerodon rupestris (Rock-Cavy)	4	14	40
Hydrochœrus capybara (Capybara) ...	18	33	114

The Agoutis and Cavies are another instance of small Rodents which come from various kinds of climates, but which have been treated as outdoor animals and show a relatively high maximum and average longevity.

LEPORIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Lepus, whole genus	23	13	71
L. americanus (American Hare)	3	2	2
L. brasiliensis (Brazilian ,,)	3	6·3	10
L. europæus (Common ,,)	10	20	71
L. nigricollis (Black-necked ,,)	1	1	1
L. sylvaticus (Wood ,,)	4	13	41
L. variabilis (Varying ,,)	2	6·5	12

Metchnikoff has set down ten years as a great age for a rabbit, and hence the record duration of nearly seven years for the common hare is not high. The very low average duration shows a poor viability. As there would seem to be no special difficulty in providing Leporidæ with conditions suitable to them, there is probably some special reason for their low viability in captivity. It is a remarkable circumstance that many of the most common wild animals of Europe are difficult to keep in captivity. I think it is quite possible that the fear of man which such animals have acquired in their wild state, almost as a necessary condition of their existence, by continuing to act after captivity, shortens the life, often by accident, often by reaction of the mental state on the general health. Animals from remoter parts of the world have not an acquired intolerance of man to lose.

Summary of Rodentia.

It is unlikely that animals in captivity reach the potential longevities of their races, and it is a new and somewhat surprising fact that Rodents live so long as these records show. There is only a rough correspondence between maximum durations and size, the figures amongst Rodents ranging from 20 years in the Porcupine, 15 in some Squirrels, 13 in Marmots, 11 in Sousliks, 9 in Agoutis and Capybaras, down to 3 in Dormice. Metchnikoff has shown (*tom. cit.*) that on the whole there is an inverse proportion between the relative capacity of the large intestines and the duration of life, animals with a capacious hind-gut usually being shorter-lived in proportion to their size than those in which the hind-gut is reduced. Rodents certainly present a marked exception to his general rule, for in their case the hind-gut and cæcum are relatively very long and very capacious. The relatively high viability of Rodents is another remarkable fact, and is most striking in comparison with Insectivora. Their high specific longevities and viabilities may be associated, I think, with the fact that they are a successful group, with remarkable power of adaptation to different environments.

The most important practical result is the very striking series of contrasts between the average and maximum durations of those animals which have had free access to fresh air and of those which have been deprived of such access by detention in heated houses,—a contrast that seems independent of the natural habitat of the animals in question.

HYRACES.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hyrax capensis (Cape Hyrax) ……	10	15·2	50
H. dorsalis (Dorsal ,,) ……	2	18·5	36

I can find no other records which would throw light on the potential longevity of these animals, the zoological position of which is very doubtful. It is impossible to tell their ages if they are adult on arrival, and therefore the maximum duration of just over four years gives no reliable indication of the potential longevity. As these animals have a most complex and capacious hind-gut, and as they are vegetable-feeders, a high viability or great longevity is not to be expected, according to Metchnikoff's views. In the period covered by these figures, the Hyraces were almost invariably given access to open air.

Capt. Stanley Flower's figures are lower.

PROBOSCIDEA.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Elephas africanus (African Elephant)	1	101	101
E. indicus (Indian ,,)	3	196	290

Metchnikoff has already pointed out that there is no exact basis for the popular ascription of very high potential longevity to these animals. It used to be thought that they could live for several centuries. Flourens, using his formula based on the age at which the epiphyses unite with the long bones, set down 150 years as the limit of their age. Indian natives ascribe a limit of from 80 to 150 years. On the other hand, the official list of the Indian Government, cited by Brehm, shows that of 138 elephants only one lived for more than 20 years after it had been purchased. Twenty to twenty-five years' duration in a menagerie is regarded as good. The record in this list of about 24 years has been far surpassed by a female Indian Elephant, brought as a young animal by the Prince of Wales from India in 1876, and still alive and apparently in quite good condition in our Gardens, although its age is certainly over 34 years. I agree with the general conclusion of Metchnikoff, that elephants, in proportion to their size, have neither a high potential longevity nor a good viability, not much more than a hundred years being the probable age limit, and twenty to thirty years a fair average duration.

UNGULATA.

1. Perissodactyla.

RHINOCEROTIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Rhinoceros, whole genus	10	110	342
R. bicornis (Two-horned African Rhinoceros).	1	271	271
R. lasiotis (Hairy-eared Rhinoceros)	3	132	342
R. sondaicus (Javan ,,)......	1	130	130
R. sumatrensis (Sumatran ,,)......	4	7·5	17
R. unicornis (Indian ,,)......	1	281	281

Rhinoceroses, like Elephants, are large vegetable-feeding mammals, with in proportion to their size a relatively low potential longevity and viability. The maximum duration in this record, nearly 29 years for a so-called "Hairy-eared" example, has since been surpassed by an Indian Rhinoceros which died after a duration of 40 years in our Gardens, and probably therefore at an age of at least 42 years. The number of examples in the record is not sufficient to make averages useful, but these and information I have received elsewhere make it clear that the viability is not good, and probably lower in the case of the African species.

TAPIRIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tapirus americanus (American Tapir) .	13	43	188
T. indicus (Malay Tapir)	2	4	5

The record of over 15 years for an American Tapir no doubt is under the potential longevity of these animals, but I can find no reliable information from other sources. The very low figures for the Malay Tapir refer only to two individuals, and there is no sufficient reason to suppose that the Asiatic species is less viable than the American. It must, however, be inferred that Tapirs in regard to their size are short-lived creatures with low viability.

EQUIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Equus, whole genus	21	116	346
E. hemionus (Kiang)	1	220	220
E. hemippus (Asiatic Wild Ass)......... (=*hemionus indicus*).	3	82	169
E. onager (Onager).......................	2	198	219
E. somalicus (Somali Wild Ass)	1	16	16
E. tæniopus (African Wild Ass)	3	175	232
E. quagga (Quagga)	1	346	346
E. burchelli (Burchell's Zebra)	7	98	268
E. grevyi (Grevy's Zebra)	2	6	10
E. zebra (Mountain Zebra)	1	46·5	62

It is well-known that the usual duration of life in horses is from 15 to 30 years, and somewhere about 50 is probably the potential longevity of the group. The record of a 29 years' duration in the case of a Quagga is therefore quite good, and if it be remembered that the figures include a number of newly imported and young animals, the average duration and viability are both good. On the other hand, they are in accordance with Metchnikoff's views as to the relatively low viability and longevity of animals with capacious hind-guts, for they are not high in proportion to the size of the animals and their ready submission to captivity.

Summary of Perissodactyla.

These animals, in consideration of the ease of procuring suitable food, do not afford evidence of high potential longevity or of great viability in proportion to their size.

2. Artiodactyla.

BOVINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Bos indicus (Zebu)	20	64·5	230
Bos taurus (English Domestic White Ox).	13	32	145
Bison americanus (American Bison)...	9	70	129
B. bonasus (European ,,)...	1	14	14
Poephagus grunniens (Yak)	5	56	107
Bibos frontalis (Gayal)	5	138	188
B. gaurus (Gaur)	1	30	30
Bubalus æquinoctialis (E. African Buffalo).	2	57	90
B. buffelus (Indian Buffalo)	1	20	20
B. caffer (Cape ,,)	2	118·5	175
Anoa depressicornis (Anoa)	2	63·5	126
All Bovines	61	63·3	230

According to Metchnikoff, the duration of life in cattle is very short considering their size. The potential longevity is probably not much over 30 years; at 5 years old they begin to show signs of age and at from 16 to 18 they lose reproductive powers. The records quoted above are wholly in accordance with this estimate; the maximum duration of nearly 20 years is good, and the average duration is what might be expected reasonably. Throughout the period in question, the cattle were kept in unwarmed shelters, with access to the open air.

Capt. Flower has no high records.

BUBALINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Bubalis boselaphus (Bubaline Antelope).	2	115	162
B. caama (Hartebeest)	3	65	85
B. tora (Tora Antelope)	3	55	86
Damaliscus albifrons (Bless-bok)	5	120	133
D. pygargus (Bonte-bok)	2	28	55
Connochætes gnu (White-tailed Gnu).	4	102·5	164
All Bubalines	19	83	162

The records of Bubaline Antelopes correspond closely with those of cattle. From their smaller size so high a potential longevity is not to be expected, whereas, on the other hand, the higher average duration is probably due to the absence of young calves, the mortality amongst which lowered the record of cattle.

CEPHALOPHINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cephalophus, whole genus	49	23	109
C. coronatus (Crowned Duiker).........	4	11	20
C. dorsalis (Bay ,,).........	7	26	75
C. grimmi (Common ,,).........	13	22·7	107
C. maxwelli (Maxwell's ,,).........	10	34	109
C. monticola (Blue ,,)	9	14·9	43
C. nigrifrons (Black-fronted Duiker)	1	3	3
C. rufilatus (Red-flanked ,,)	4	27	38
C. sylvicultrix (Yellow-backed ,,)	1	3	3
Tetraceros quadricornis (Four-horned Antelope).	19	28	66

The maximum and average durations of the Cephalophine Antelopes are rather lower in proportion to their size than those of the Bubaline Antelopes. There has been omitted from the tables, however, a considerable number of examples that lived less than a month in the Gardens.

NEOTRAGINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Oreotragus saltator (Klipspringer)	1	46	46
Raphicerus melanotis (Grys-bok).........	2	6·5	10
R. tragulus (Stein-bok)	2	3	4
Ourebia nigricaudata (Gambian Ourebi).	3	40	105

The number of individuals is too small to make inferences useful.

CERVICAPRINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cobus ellipsiprymnus (Common Water-buck).	3	39·3	47
C. unctuosus (Sing-sing Water-buck).	4	100	183
Cervicapra isabellina (Isabelline Antelope).	2	19	36
C. bohor (Bohor Antelope)	2	43	83
ANTILOPINÆ.			
Gazella, whole genus	118	24·4	112
G. arabica (Arabian Gazelle)............	20	18	71
G. bennetti (Indian ,,)...........	11	10·8	57
G. cuvieri (Cuvier's ,,)...........	1	3	3
G. dorcas (Egyptian ,,)...........	27	22·7	94
G. euchore (Spring-bok)	9	20	65

ANTILOPINÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Gazella loderi (Loder's Gazelle)	1	55	55
G. marica (Marica ")	2	41	71
G. mohr (Mohr's ")	1	58	58
G. muscatensis (Muscat ")	8	18	45
G. rufifrons (Korin ")	2	21	38
G. sœmmerringi (Sœmmerring's Gazelle).	8	31	69
G. spekii (Speke's Gazelle)	2	47·5	73
G. subgutturosa (Persian Gazelle)......	26	33·5	112
Antilope cervicapra (Indian Antelope).	7	36	100

The Gazelles in proportion to their size have a good maximum and average duration.

HIPPOTRAGINÆ.

Hippotragus equinus (Equine Antelope).	1	123	123
H. niger (Sable Antelope)	2	68	89

ORYGINÆ.

Oryx, whole genus	15	83	216
O. beatrix (Beatrix Antelope).........	6	24	90
O. beisa (Beisa ").........	4	129	177
O. leucoryx (Leucoryx ").........	5	127	216
Addax naso-maculatus (Addax Antelope).	2	178	219

With exception of the Beatrix Antelope the members of this fair-sized and handsome group display a remarkable longevity, 18 years being the record, and a high average viability.

TRAGELAPHINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Oreas canna (Eland)	16	71	118
Strepsiceros kudu (Kudu)	6	35	94
S. imberbis (Lesser Kudu)	2	44·5	80
Tragelaphus gratus (Pleasant Antelope)	2	42·5	78
T. scriptus (Harnessed Antelope)......	12	36	72
T. sylvaticus (Bosch-bok)	4	49	82
Boselaphus tragocamelus (Nylghaie) ...	9	71·4	146

The large Tragelaphine Antelopes have a proportionally high maximum duration and their average duration shows that even including the Kudu, which has been supposed to be specially delicate in London, they have a good viability.

RUPICAPRINÆ.

Rupicapra tragus (Alpine Chamois) ...	1	24	24
Nemorhædus goral (Goral Antelope) ...	1	212	212

The most striking feature about these records of Antelopes is that in proportion to their size, they appear to have better lives than the cattle. Within the group there is a fairly close correspondence between size and duration, but a few species such as the Beatrix and the Chamois are specially delicate. The conditions under which these animals have been kept vary as to the provision of artificial heat, most of the Gazelles having been least well provided with it, but in nearly every case there has been access to the open air.

Capt. Flower's records of maximum duration are specially interesting, as it is to be expected that the climate of Egypt would be specially favourable to Antelopes. His highest figures, however, do not differ much from ours; 8 years for a *Cobus defassi*, still alive, over 11 years for a Dorcas Gazelle, 10 years for a Sœmmerring's Gazelle and for a Sabre-horned Oryx.

CAPRINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Capra, whole genus	50	50	166
C. ægagrus (Grecian Ibex)	5	59	157
C. caucasica (Caucasian Ibex)	2	54·5	78
C. hircus (Angora Goat)	18	53·5	166
C. hispanica (Spanish Ibex)	1	32	32
C. ibex (Alpine ,,)	2	103	103
C. megaceros (Markhoor)	15	55	133
C. nubiana (Nubian Ibex)	6	24	101
C. sinaitica (Sinaitic ,,)	1	45	45
Hemitragus jemlaicus (Thar)	10	51	143
Ovis, whole genus	68	46	231
O. blanfordi (Blanford's Sheep)	1	46	46
O. burrhel (Burrhel Wild Sheep)	21	46·7	193
O. cycloceros (Punjab ,, ,,)	6	51	137
O. hodgsoni (Great Tibetan Sheep)	2	20	31
O. musimon (Mouflon)	15	50	231
O. tragelaphus (Barbary Wild Sheep)	21	43	134
O. vignei (Urial)	2	15	28

Sheep and goats are supposed to have a shorter life than cattle. Metchnikoff, quoting Grindon, assigns 14 years as an extreme age for domestic sheep, 12 an old age, and 8 to 10 as the time when senile changes are expected. These records show that wild species of sheep and goats may attain great ages, a goat having lived about 14 years and a Mouflon over 19 years in the Gardens. The average duration is lowered by the number of lambs the life of which was not good, and if this allowance be made, it is clear that the sheep and goats have a fairly good viability. They are of course kept with free access to the open air.

Capt. Flower gives no higher records.

ANTILOCAPRIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Antilocapra americana (Pronghorn)	6	9	30

Pronghorn Antelopes are notoriously delicate in captivity, not only in London, but in other zoological collections. The records afford no information as to the specific longevity, and only confirm knowledge as to the low viability of these animals.

GIRAFFIDÆ.			
Giraffa, whole genus	10	101·9	229

It is to be expected that Giraffes, in correspondence with their large size, should have a relatively great specific longevity compared with other ruminants. The record, a duration of over 19 years, is just surpassed by that of a Zebu, and whilst it is fairly high, is certainly not high in proportion to the great size of the animal. The average duration shows a fairly good viability. Giraffes have always been given artificial heat in cold weather, and for the most part have been allowed access to the open air only in summer.

Capt. Flower records a Giraffe still alive after 8 years' duration.

CERVIDÆ.

MOSCHINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Moschus moschiferus (Musk-deer)	4	26	65

Musk-deer have shown a low viability. There is some difficulty as to their food in captivity, as their natural diet of twigs and buds is difficult to supply; they are animals capable of surviving extreme exposure to cold, and in captivity have probably been subjected to too much artificial warmth.

CERVINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cervulus, whole genus	14	71	126
C. crinifrons (Hairy-fronted Muntjac).	1	73	73
C. lacrymans (Crying Muntjac)	1	126	126
C. muntjac (Indian ,,)	7	39	96
C. reevesi (Reeves's ,,)	5	105	121
Elaphodus michianus (Michie's Tufted Deer).	9	16	46
Cervus, whole genus	173	68·8	243
Red-deer group.			
Cervus elaphus (Red Deer)..............	17	69	191
C. kashmirianus (Kashmir Deer)	1	148	148
C. maral (Persian ,,)	3	98	172
C. luehdorfi (Lühdorf's ,,)	2	52·5	79
C. canadensis (Wapiti ,,)	10	156·9	243

Sika group.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cervus sika (Japanese Deer)	39	52	160
C. mantchuricus (Mantchurian Deer)	4	116	170
C. taevanus (Formosan ,,)	4	95	149
Axis group.			
C. axis (Axis Deer)	27	56	158
Sambar group.			
C. aristotelis (=*unicolor*) (Sambar Deer)	17	48	142
C. hippelaphus (Rusa Deer)	3	26	33
C. moluccensis (Molucca ,,)	12	69	219
C. philippinus (Philippine ,,)	3	55	56
C. kuhli (Kuhl's ,,)	2	37	66
C. alfredi (Prince Alfred's ,,)	5	51	93
C. porcinus (Hog ,,)	16	60·5	119
Swamp Deer group.			
C. duvaucelli (Barasingha Deer)	1	220	220
C. schomburgki (Schomburgk's ,,)	1	157	157
C. eldi (Panolia ,,)	3	58	91
C. davidianus (Père David's Deer)	3	49	92
Dama mesopotamica (Persian Fallow Deer).	8	60	124
D. vulgaris (Common Fallow Deer)	8	42	120
Alces machlis (Moose)	6	32·7	62
Hydropotes inermis (Chinese Water-Deer).	3	70	129
Capreolus capræa (Common Roe-deer).	9	24	52
C. pygargus (White-rumped Roe-deer).	1	6	6
Cariacus, whole genus	83	31	146
C. campestris (Pampas Deer)	6	12	24
C. gymnotis (Naked-eared Deer)	5	14·5	40
C. leucurus (White-tailed ,,)	1	69	69
C. macrotis (Mule ,,)	24	49	146
C. mexicanus (Mexican ,,)	18	31	91
C. nemorivagus (Wood Brocket)	7	17	32
C. rufus (Red ,,)	6	13	35
C. virginianus (Virginian Deer)	16	27	81
Furcifer chilensis (Gemul ,,)	1	131	131
Pudua humilis (Pudu ,,)	4	31	108
Rangifer tarandus (Reindeer)	11	41	116

Stags are supposed to be long-lived animals, and Flourens has set down 30 to 40 years as the duration of their lives. The longest record on this list, over 20 years in the case of a Wapiti, does not lead one to infer that in proportion to their size the potential longevity of Cervidæ differs much from that of other ruminants. Within the group, there is the usual rough correspondence between duration and size, the larger animals reaching greater ages and being hardier than the smaller animals; the records of average duration are lower, in some cases (*e. g.* Sika, Axis and Red Deer), reduced by breeding, the mortality amongst the young being heavy. Some kinds of Deer have a specially low viability in captivity, as for instance the Moose, most probably on account of the difficulty of supplying it with natural food, whilst all Deer of the genus *Cariacus* except the Mule Deer appear to be naturally delicate. The vast majority of the deer have been kept under similar conditions, with unwarmed shelters and free access to the open air.

Capt. Flower's highest record is that of an Axis-deer, still alive after over 9 years' duration.

TRAGULIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tragulus, whole genus	28	11·4	50
T. javanicus (Javan Chevrotain)	10	9·9	43
T. meminna (Indian ,,)	9	12	33
T. stanleyanus (Stanley's ,,)	9	12	50
Hyomoschus aquaticus (Water Chevrotain).	11	4	11

Nothing is known as to the potential longevity of Chevrotains, and the record of over four years would appear to be considerably lower than what might be anticipated for these animals. The viability in captivity is very low, and the records of average duration would be much lower if a considerable number of examples that lived for less than a month had been included. These animals have always been assumed to require special protection from cold and have been kept in warmed houses without access to the open air.

CAMELIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Lama, whole genus	14	69	187
L. huanacos (Huanaco)	6	72	187
L. pacos (Alpaca)	2	9	14
L. peruana (Llama)	6	95	156
Camelus dromedarius (Dromedary)	6	44	145
C. bactrianus (Bactrian Camel)	5	110	204

Flourens has set down the life of a Camel as reaching to 40 years, but the longest record amongst the Camelidæ is only 17 years. A Llama that died at the Gardens recently, after a duration of 15 years, showed plain evidence of senile degeneration. The figures of average and maximum duration show that the Camelidæ, notwithstanding their size, and the absence of difficulty in providing appropriate food and accommodation, are not long-lived animals.

HIPPOPOTAMIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hippopotamus amphibius (Hippopotamus).	3	290	335

The maximum duration of nearly 28 years has been surpassed by a female Hippopotamus, born in the Gardens and which recently died at the age of 39 years. The viability of these animals is good, if they are sufficiently protected from cold in winter, but it is to be noticed that if the maximum ages attained give any indication of the potential longevity, the Hippopotamus, in proportion to its size, cannot be regarded as a long-lived animal.

PHACOCHŒRIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Phacochœrus africanus (Ælian's Warthog)	1	24	24
P. æthiopicus (Æthiopian Warthog)......	6	55	131
SUIDÆ.			
Sus, whole genus	25	55	234
Sus andamanensis (Andaman Swine) ...	2	134	147
S. cristatus (Indian Wild Swine)	2	54·5	89
S. leucomystax (White-whiskered Swine)	5	65·8	158
S. papuensis (Papuan Pig)	1	74	74
S. scrofa (Wild Swine)	15	40	234
Porcula salvania (Pigmy Hog)	5	48	90
Babirussa alfurus (Babirussa)	6	41	126
Potamochœrus africanus (Southern River-Hog)	5	86	176
P. penicillatus (Red River-Hog)	6	4	11
Dicotyles labiatus (White-lipped Peccary)	5	71	112
D. tajaçu (Collared Peccary)	20	22·9	162

The maximum duration of nearly 20 years for one of the Wild Swine corresponds with the limits that various authors have assigned to such animals. The viability is not good, and the average would be much lower if a number of animals whose duration was less than a month had not been omitted. Capt. Flower's highest records are that of a Wild Swine still alive after 12 years' duration, and a Babirussa alive after 9 years' duration.

Summary of Artiodactyla.

The Artiodactyla contain animals of so many different kinds, that we cannot expect to find a close correspondence between size and longevity throughout the whole group, although on the whole such a correspondence exists throughout the subgroups. The group as a whole is not notable for longevity in proportion to size, and as the majority are vegetable-feeders with capacious hind-gut and great tendency to intestinal putrefaction, the general condition is in agreement with Metchnikoff's theory. Antelopes, sheep and goats, and deer appear in proportion to their size to have better viability than cattle, giraffes and camels, whilst on the whole the non-ruminants are hardier, in proportion to their size, than the ruminants.

CETACEA AND SIRENIA.

Very few examples are contained in the records, and the duration of these was only sufficient to show the complete unsuitability of the conditions and certainly afforded no indication as to the general viability and longevity of these animals. There is of course abundant evidence from other sources as to the high potential longevity of Cetaceans, but I know of no definite evidence with regard to Sirenians, which as vegetable-feeders with complicated intestines might be supposed to have short lives in proportion to their bulk.

EDENTATA.

BRADYPODIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Bradypus tridactylus (Three-toed Sloth).	8	under 1	1
Cholopus didactylus (Two-toed Sloth) ...	2	7	13
C. hoffmanni (Hoffmann's Sloth)	14	29	133

I am ignorant as to any recorded information regarding the potential longevity and viability of Sloths. Lydekker, in the Royal Natural History, remarks on their power of recovery from injury and capacity for enduring long periods of starvation, correlating these qualities with general low organization, and comparing the animals with reptiles. Certainly, however, it cannot be assumed that creatures of low organization have a relatively high potential longevity. As Sloths are rather small, vegetable-feeding animals, with fairly bulky hind-guts, on Metchnikoff's theory, their duration of life and viability ought to be low. The maximum record of over 11 years for a Hoffmann's Sloth is certainly high, but the average duration of Sloths is extremely bad. The failure has been complete in the case of the Three-toed Sloths, very great with the Two-toed, whilst there has been a partial but very irregular success in the case of Hoffmann's Sloth. Sloths are nocturnal inhabitants of tropical forests, and in captivity they have been assigned confined quarters in warmed houses, without access to the open air. Their quiescence by day probably has led to the need of air and exercise at night being overlooked.

DASYPODIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tatusia hybrida (Mulito Armadillo) ...	6	8·5	40
T. peba (Peba Armadillo)	16	17	45
T. kappleri (Kappler's Armadillo)	2	53	54
Dasypus minutus (Little Armadillo) ...	6	19	23
D. sexcinctus (Six-banded Armadillo) ...	6	9·3	19
D. villosus (Hairy Armadillo)	31	33	157
Xenurus unicinctus (Broad-banded Armadillo).	2	6	11
Tolypeutes tricinctus (Brazilian Three-banded Armadillo).	1	8	8

Regarding the potential longevity of Armadillos, I am unaware of any recorded information. They live on carrion, insects and vegetables, and the hind-gut is of very moderate relative capacity. The record of 13 years for a Hairy Armadillo seems good, but the average duration is very much less than that. Throughout the period in question most of the Armadillos were kept in the interior of a badly ventilated and very warm room.

Capt. Flower records a duration of over 8 years for a Hairy Armadillo.

MYRMECOPHAGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Myrmecophaga jubata (Great Ant-eater).	10	46	172
Tamandua tetradactyla (Tamandua Ant-eater).	12	10·8	60

The records of 14½ years for a Great Ant-eater and 5 years for a Tamandua Ant-eater are very much in excess of the average duration of these animals. They have always been carefully protected from cold, and not allowed access to the open air. It is plain that they are creatures of low viability compared with their potential longevity, but that they have been subjected to very unsuitable conditions.

MANIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Manis tricuspis (White-bellied Pangolin).	1	1	1
M. (Pholidotis) gigantea (Giant Pangolin).	1	1	1

The records only testify to the failure to keep these animals in captivity.

ORYCTEROPIDÆ.			
Orycteropus capensis (Cape Ant-bear) ...	4	52	117
O. æthiopicus (Æthiopian Ant-bear) ...	1	17	17

The record of over 9 years for a Cape Ant-bear gives an indication that these animals are able to live to a considerable age. The difference between the maximum and average durations shows the low viability of these animals under the conditions of their captivity. In the period in question they have been kept in heated houses without access to open air.

Summary of Edentata.

The most notable feature in the records is their great variation. The maximum durations are sufficient to deduce from them that these animals have a fairly high potential longevity which varies roughly with their size, and that their viability is low under the conditions in which they have been kept.

MARSUPIALIA.

MACROPODIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Macropus, whole genus	200	30·2	166
M. agilis (Agile Wallaby)	5	21	43
M. bennetti (Bennett's ,,)	35	30	112
M. billardieri (Red-bellied ,,)	7	12	38
M. brachiurus (Short-tailed Wallaby)	15	16	41
M. derbianus (Derbian ,,)	19	38	118
M. dorsalis (Black-striped ,,)	8	23	62
M. giganteus (Great Kangaroo)	30	31	137
M. melanops (Black-faced Kangaroo)	13	37	164
M. parryi (Parry's Wallaby)	1	5	5
M. robustus (Great Wallaroo)	15	25	83
M. ruficollis (Rufous-necked Wallaroo)	6	14	28
M. rufus (Red Kangaroo)	30	43·8	166
M. thetidis (Thigh-striped Wallaby)	4	26	54
M. ualabatus (Black-tailed ,,)	12	30	76
Petrogale, whole genus	44	30	89
P. brachyotis (Short-eared Kangaroo)	1	3	3
P. penicillata (Brush-tailed ,,)	15	31	89
P. xanthopus (Yellow-footed Rock Kangaroo).	28	31	79
Onychogale frenata (Bridled Wallaby)	12	5·3	10
O. unguifera (Nail-tailed ,,)	6	1	2
Dorcopsis luctuosus (Mourning Kangaroo)	1	7	7
D. mülleri (Müller's Kangaroo)	1	15	15
Dendrolagus inustus (Brown Tree Kangaroo).	1	19	35
D. bennetti (Bennett's Tree Kangaroo).	4	18	43
Æpyprymnus rufescens (Rufous Rat-Kangaroo).	19	35	70
Bettongia, whole genus	24	40	94
B. cuniculus (Tasmanian Rat-Kangaroo).	3	29	59
B. gaimardi (Gaimard's ,, ,,).	15	30	79
B. lesueuri (Lesueur's ,, ,,).	3	78	94
B. penicillata (Ogilby's ,, ,,).	3	52	87
Potorous tridactylus (Common Rat-Kangaroo).	5	13	16
PHALANGERIDÆ.			
Dromicia nana (Dormouse Phalanger).	4	26·5	64
Petaurus, whole genus	48	40	130
P. australis (Yellow-bellied Phalanger).	2	92·5	121
P. breviceps (Short-headed ,,).	32	33	130
P. sciureus (Squirrel-like ,,).	14	48	123
Pseudochirus peregrinus (Ring-tailed Phalanger).	1	4	4
Trichosurus, whole genus	71	22	142
T. caninus (Short-eared Phalanger)	1	89	89
T. fuliginosus (Sooty ,,)	7	27	76
T. orientalis (Oriental ,,)	1	3	3
T. vulpecula (Vulpine ,,)	62	21	142
Phascolarctos cinereus (Koala)	3	5·6	8

It is impossible to separate, by any important characters, the Kangaroos, Wallabies, Rock Kangaroos, Rat-Kangaroos, and Phalangers. They form a series roughly corresponding with the ruminants amongst higher mammals, and have similar habits and food. The alimentary tract, although much simpler in structure than that of ruminants, possesses a capacious hind-gut and cæcum, and they are therefore animals that might be expected to have low potential longevity and poor viability. The maximum duration in the group, nearly 14 years in the case of a kangaroo, is more or less what might be expected, and on the whole there is a rough correspondence between size and longevity. The average duration is low compared with the maximum duration, and it is a fair inference that the viability is not good. Amongst the Phalangers, however, there are remarkable exceptions, the maximum duration and the average duration, in a number of cases, being unusually high in proportion to size. In reflecting upon this I was disposed at first to distrust the records; in animals so little individualized it might well be that mistakes had been made as to individuals, and hence that wrong durations had been assigned in the records. Although this may well have happened in some of the cases, it is not a sufficient explanation. A period of 33 years is covered by the records, and even where the number of individuals was largest, the number of individuals alive at any one time was probably not more than 3 or 4 at most, and the chance of confusion was therefore not great; there are moreover cases of remarkable duration where the number of individuals was so small as to make confusion practically or absolutely impossible,—of two Yellow-bellied Phalangers, for instance, one lived over 10 years, and one Short-eared Phalanger lived over 7 years. It is clear that these animals have a high viability. In the period covered by the record some of them were kept in fairly roomy cages, but in an artificially heated house without access to the open air. Others were kept in small outdoor cages with no artificial heat. Unfortunately I cannot now trace which individuals lived in these very different kinds of quarters. Since the period in question several species have thriven in a shed open to the outer air, without artificial heat, but with protection from wind. Capt. Flower records a Great Grey Kangaroo, a Black-faced Kangaroo, and a Wallaroo, each alive after 10 years' duration.

PHASCOLOMYIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Phascolomys, whole genus	13	74	212
P. latifrons (Hairy-nosed Wombat)	4	88	212
P. mitchelli (Common ,,)	9	68	189

A record of nearly 18 years for a Wombat seems to show that these animals have a high potential longevity in proportion to their size, whilst their viability, as shewn by the average duration, is good. Throughout the period, they were kept in an unheated shelter with free access to the open air.

PERAMELIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Peragale lagotis (Rabbit-eared Bandicoot).	8	19·8	32
Perameles obesula (Short-nosed ,,).	3	8	17

These little omnivorous and carnivorous marsupials show low maximum and average durations. They have a capacious hind-gut and cæcum in proportion to their size. They have been kept in small cages in a heated house, without access to fresh air, and have not done well.

DASYURIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Thylacinus cynocephalus (Tasmanian Wolf).	7	43	103
Sarcophilus ursinus (Tasmanian Devil) .	7	52·5	61
Dasyurus, whole genus	44	33	82
D. maculatus (Spotted-tail Dasyure) ...	5	37	75
D. viverrinus (Maugé's ,,)	39	28·5	82

Compared with Carnivora of similar sizes, the maximum duration of these carnivorous marsupials is not so high, suggesting possibly a low potential longevity. On the other hand, the average duration is rather better in proportion, which may be evidence of a greater viability. The conditions under which they have been kept are similar to those of true Carnivora: larger forms like the Thylacine have been given unheated shelters with access to the open air; the smaller forms, for the most part, have been confined in artificially warmed houses.

DIDELPHYIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Didelphys, whole genus	92	10·8	85
D. azaræ (Azara's Opossum)	20	8	28
D. cancrivorus (Crab-eating Opossum).	31	13	85
D. cinereus (Cinereous ,,).	1	5	5
D. crassicaudata (Thick-tailed ,,).	5	16	28
D. lanigera (Woolly ,,).	6	19	53
D. murina (Murine ,,).	2	1·5	2
D. nudicaudata (Rat-tailed ,,).	2	9	14
D. opossum (Quica ,,).	9	11	22
D. philander (Philander ,,).	4	4·7	9
D virginiana (Virginian ,,).	12	8	16

The Opossums, which are omnivorous and carnivorous, display low maximum and average durations, and so far as this evidence goes would appear to have a relatively low potential longevity and a poor viability. On the other hand, they have been treated as animals requiring protection from cold at all costs, and have been kept in artificially warmed houses without access to the open air.

Summary of Marsupialia.

The records show in the first place that whilst within the different divisions of Marsupials, there is frequently a close correspondence between size and longevity, there is no such relation if the group be considered as a whole. The maximum duration was that of a Wombat which lived nearly 18 years in the Gardens; next comes a Kangaroo with a duration of 14 years; then some small Phalangers reaching nearly 12 years; then a Thylacine reaching nearly 9 years. It is notable that much the best records are in the case of animals which have had good access to air; the chief exception, and this only a doubtful one, is that of the Phalangers.

MONOTREMATA.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Echidna hystrix (Echidna)	4	1·5	5

The records are sufficient only to show the failure, in the period in question, to provide suitable conditions for these animals. They have always been kept in artificially heated houses.

SUMMARY OF MAMMALIA.

It is advisable to repeat here that the material on which this communication is based, is defective in certain important respects. No information was available as to the condition of the animals on their arrival. I have tried to eliminate this source of error to a certain extent, by omitting in most cases entries of animals that had lived less than a month in the Gardens. Similarly, no information as to the age of entrants was available. It is obvious that the heavy incidence of mortality in very young animals is an important factor independent of the special conditions of captivity, whilst the possibility of duration is naturally less in old animals than in young adults. These defects probably have abnormally lowered the records of average and of maximum duration, but to what extent I am unable to guess. At the beginning of 1911, I put into operation a system suggested to me by my friend Mr. J. L. Bonhote, F.Z.S., and I hope that thirty years after this, someone will be in a position to institute an enquiry similar to the present communication to the Society, but based on more exact data. In every case where it is possible, a card is prepared for each new arrival at the Gardens; on the face is placed the name, and mode and date of acquisition of the animal; on the reverse is entered the first place of detention, the apparent condition of health, and any indications of age ("very young," "adult," or "old adult," unless exact particulars are known); the card follows the animal to each successive house in which it may come to be placed; the dates of such changes and any important events in its history are noted; finally, at the Prosectorium, the date and cause of death are entered, with any further data as to age that may be available.

In the meantime, however, it is possible to gain considerable information, at least of a comparative kind, from such records as I had at my disposal.

Uncertainty of age and varying conditions of health on arrival, and the abnormal conditions during detention, make it doubtful if the maximum durations at the Gardens give very reliable evidence as to the potential longevities of the species concerned. The following conclusions, however, have some foundation, at least if taken relatively. Amongst Primates, the Anthropoids have a lower potential longevity than man, and longevity decreases gradually towards the smallest monkeys, whilst in the case of Lemurs it rises considerably. The potential longevity of Carnivora is relatively high, and wherever the conditions are reasonably favourable, cases of long life in proportion to size are abundant. Insectivora have low potential longevity. Rodents have an unexpectedly high potential longevity, there being many cases of unusually great age, in proportion to size. Elephants and the larger Ungulates have low potential longevities in proportion to their size; all Ruminants have a relatively low potential longevity, and the correlation with size is absent, or almost reversed; in proportion to their size, many of the smaller forms, such as Sheep and Goats, are much longer lived than Giraffes, Elands, or Cattle. Edentates supply a number of examples pointing to a high potential longevity; whilst Marsupials generally, with exceptions, such as Wombats and Phalangers, have a relatively low potential longevity.

Metchnikoff has elaborated the view that a chief cause of senility is auto-intoxication from intestinal putrefaction, and that, on the whole, those animals with the most capacious cæca, large intestines and rectums, have the shortest lives in proportion to their size and organization. The inferences from the maximum and average durations recorded here, are in general agreement with this view; the number of instances of animals and groups of animals with relatively capacious hind-guts and short and fragile lives being very great. The most notable exceptions are some of the Rodents, for instance Squirrels and Porcupines, and some of the Marsupials, such as Wombats and Phalangers, which, although they have relatively capacious hind-guts, have relatively high viability and longevity. It must be noted, however, that if the data were such as to exclude the unfavourable effect of the special conditions in captivity, these exceptions might disappear. I think the general proposition is true, that in proportion to its size, an animal with a short hind-gut is hardier and has an expectation of longer life.

The most important inference that I draw from these records is the complete failure in practice of the theory that protection from cold by artificial heat is the fundamental requisite for mammals in captivity. In the long list of mammals, belonging to nearly every group, and coming from every part of the world, there is no case of the successful application of this method, that is to say, there is no case where the maximum duration is near what might be expected, and the average duration bears a reasonable relation to the maximum. Individual exceptions, or knowledge from other sources, show us the ages to which animals may attain ; the records show the complete failure to get near what is possible. Where comparative experiments have been made the contrast is amazing. Compare the large cats, which were relatively well housed, with the small cats, which were confined in an overheated house without access to open air ; compare the civets, which were kept out of doors, with the genets and paradoxures, kept in a heated house ; the larger canines with the smaller forms ; the ratels and badgers (unheated) with other mustelines (heated) ; the raccoons (unheated) with coatis (heated); the squirrels and porcupines (unheated) with most of the other rodents (heated) ; the larger marsupials and wombats (unheated) with the smaller marsupials (heated).

The most fatal type of housing for any mammal (or bird) is being confined to the interior of a warmed house, without free access to the open air. The conditions of course are very complex, and I do not suggest that the provision of heat is in itself an evil. The ideal throughout the period I am discussing, and which still maintains an evil existence in the minds of a majority of those who have to do with living animals, is that, in the first place, animals have to be kept warm. Warmth having been secured, the more advanced persons have consented to, or even urged, the advantage of ventilation, moistening of the air, and so forth. The idea, however, is wrong. The first requisite is free access to the open air, the next is light, space and cleanliness ; these things having been secured, any form of heating that may be thought advisable, may be added *in so far as it does not in any way interfere with the primary considerations.* So far as I can judge from my experience and observations, the maintenance of an equable temperature, and probably even a greater amount of heat than is usually provided, is important in the case of reptiles and of young or sick mammals or birds. Adult mammals and birds, if in a normal state of health and if provided with tolerable space for exercise, not only do not require an equable temperature, but thrive better if they are subjected to changes of temperature. The best possible conditions for them are free access to large open-air enclosures, with adequate wind-screens, and with the possibility of retreat to small, dry shelters, which may or may not be provided with some form of artificial heat. The smaller such shelters are the better, and certainly they should not be, whether heated or unheated, part of a building to which visitors have access. In a much larger number of cases than is generally supposed, if such shelters are small and dry, and provided with appropriate bedding, artificial heat is unnecessary.

Mammals and birds, if they have room for exercise in fresh air, not only can maintain the heat of their bodies, but as a direct reaction to the stimulation of air and change of temperature, improve in general vitality and in the quality of their hair, fur, or feathers. Their viability is in a large measure determined by their power of resistance to bacterial and probably other parasites. It is impossible to ward off infection altogether, but the general condition of the body and exposure to light and air are the most certain preservatives.

It appears to be certain that although infection by a very few parasites (microscopic or macroscopic), as these are living creatures with the power of reproduction, is theoretically enough to contaminate an animal, yet, in actual practice, a fairly heavy bombardment of parasites is necessary. Confinement in heated houses not only weakens the natural power of resistance, but affords the greatest opportunity for heavy bombardment. Exposure to cold, light and air rapidly destroy a vast proportion of the parasites or their eggs or embryoes that are not in actual occupation of their host, and warmed houses afford the best possible environment for them. I do not doubt, that by reducing artificial heating as much as possible, and by making the shelters as small and as easy to clean as possible, the damaging effect of parasitic infection could be reduced enormously.

AVES.

PASSERES.

TURDIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Turdus, whole genus	68	46·7	154
T. albiventris (White-bellied Thrush).	2	10·5	20
T. cardis (Grey Thrush)	2	52·5	64
T. falklandicus (Falkland Island Thrush).	1	32	32
T. flavipes (Brazilian Grey Ousel)	1	30	30
T. iliacus (Redwing)	9	40	75
T. leucomelas (Brown Thrush)	5	67	119
T. merula (Blackbird)	7	59	135
T. migratorius (American Robin)	11	61	154
T. musicus (Song-Thrush)	4	74	137
T. mustelinus (Wood-Thrush)	4	14	29
T. pœcilopterus (Grey-winged Blackbird).	1	12	12
T. pilaris (Fieldfare)	8	29	53
T. rufiventris (Red-bellied Thrush)	3	67	95
T. torquatus (Ring-Ousel)	5	47	93
T. tristis (Sorry Thrush)	2	57	103
T. viscivorus (Missel Thrush)	3	8	12
Geocichla citrina (Orange-headed Ground Thrush).	2	27	50
G. wardi (Pied Ground Thrush)	1	12	12
Monticola cyanus (Solitary Thrush)	7	18	46
M. saxatilis (Rock ,,)	6	24·5	40
Myiophonus horsfieldi (Horsfield's Whistling Thrush).	1	62	62

TURDIDÆ (*cont.*).	No. of Indiv.	Max. dur. in months.	Av. dur in months
Saxicola œnanthe (Wheatear)	11	12	62
Pratincola rubetra (Whinchat).........	7	9	22
Ruticilla phœnicurus (Redstart)	4	4	7
R. tithys (Black Redstart)...............	1	4	4
Cyanecula suecica (Blue-throat)	1	27	27
Erithacus rubecula (Red-breast)	4	10	16
Miro albifrons (South Island Robin) .	4	9	28
Copsychus saularis (Indian Dial-Bird).	9	39	133
Cittocincla macrura (Indian Shama)...	4	46	53
Sialia wilsoni (Common Bluebird) ...	29	20	54
Daulias luscinia (Nightingale).........	21	16	45
Sylvia, whole genus	21	9	27
S. atricapilla (Blackcap)	13	10	27
S. cinerea (Whitethroat)	3	9	20
S. curruca (Lesser Whitethroat)	3	8	14
S. sylvicola (Wood Warbler)...........	1	5	5
S. trochilus (Willow ,,)...........	1	2	2
Acrocephalus streperus (Reed-Warbler).	1	5	5
Accentor collaris (Alpine Accentor) ...	11	23	52
A. modularis (Wood Sparrow)	1	41	41
Mimus polyglottus (Northern Mocking Bird).	26	23	79
M. saturninus (Saturnine Mocking Bird).	3	31	47
Galeoscoptes carolinensis (Cat-bird) ...	3	19	51
Harporhynchus rufus (Brown Mock Thrush).	3	31	71
Cichlherminia densirostris (White-eyed Mock Thrush).	1	16	16
CINCLIDÆ.			
Cinclus aquaticus (Dipper)	7	7	26
PANURIDÆ.			
Panurus biarmicus (Bearded Titmouse).	14	8	31
PARIDÆ.			
Parus, whole genus	55	18	108
P. ater (Coal Titmouse)..................	4	16	30
P. borealis (Northern Titmouse)......	5	32	73
P. caudatus (Long-tailed ,,)......	2	4	5
P. cæruleus (Blue ,,)......	9	18	29
P. cristatas (Crested ,,)......	2	1·5	2
P. cyanus (Azure ,,)......	3	11	12
P. major (Great ,,)......	14	21	108
P. palustris (Marsh ,,)......	3	18	40
P. varius (Red-sided ,,)......	13	15	36
Liothrix luteus (Yellow-bellied Liothrix).	41	27	100

Sittidæ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sitta cæsia (Common Nuthatch)	11	10	57
Motacillidæ.			
Motacilla, whole genus	28	17	60
M. flava (Blue-headed Wagtail)	7	11	27
M. lugubris (Pied ,,)	10	12	45
M. melanope (Grey ,,)	8	24	60
M. raii (Yellow ,,)	3	33	51
Anthus, whole genus	10	13·8	43
A. arboreus (Tree Pipit)	4	14	24
A. obscurus (Rock ,,)	2	28·5	43
A. pratensis (Meadow Pipit)	3	7	18
A. spipoletta (Water ,,)	1	2	2
Grallina australis (Australian Pipit)	2	11	20
Pycnonotidæ.			
Pycnonotus, whole genus	41	31	132
P. atricapillus (Black-capped Bulbul).	1	12	12
P. crocorrhous (Yellow-vented ,,).	1	15	15
P. hæmorrhous (Red-vented ,,).	12	46	132
P. jocosus (Red-eared ,,).	10	26·6	79
P. leucotis (White-eared ,,).	8	32·3	91
P. sinensis (Syrian ,,).	4	11	23
P. xanthopygos (Chinese ,,).	5	24	83
Hemixos flavala (Brown-eared ,,).	3	27	62
Hypsipetes maclellandi (Rufous-bellied Bulbul).	2	77	114
Chloropsis aurifrons (Malabar Green Bulbul).	3	22	39
C. hardwickii (Blue-winged Bulbul)	1	130	130
Crateropodidæ.			
Garrulax, whole genus	26	50	107
G. albogularis (White-throated Jay-Thrush).	3	15	77
G. chinensis (Chinese Jay-Thrush)	11	61	107
G. leucolophus (White-crested Jay-Thrush).	7	47	98
G. pectoralis (Black-gorgetted Jay-Thrush).	2	31	42
G. perspicillatus (Masked Jay-Thrush).	2	91	103
G. picticollis (Collared ,,).	1	97	97
Turnagra crassirostris (South Island Thrush).	5	15·4	26
Sibia capistrata (Black-headed Sibia).	3	44	61
Leucodioptron canorum (Melodious Jay-Thrush).	6	30	81

CRATEROPODIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Grammatoptila striata (Striated Jay-Thrush).	4	8	14
Struthidea cinerea (Grey Struthidea).	5	93	223
Hypocolius ampelinus (Grey Hypocolius).	4	56	68
ORIOLIDÆ.			
Sericulus melinus (Regent Bird)	5	33	84
Oriolus, whole genus	5	12	31
O. indicus (Black-naped Oriole)	1	14	14
O. kundoo (Sykes's ,,)	3	15	31
O. melanocephalus (Black-headed Oriole)	1	1	1
DICRURIDÆ.			
Chibia hottentotta (Indian Drongo) ...	1	4	4
Artamus, whole genus	12	15·6	20
A. fuscus (Dull Wood Swallow)	1	8	8
A. personata (Masked Wood Swallow).	1	20	20
A. sordidus (Sordid ,, ,,).	4	13	20
A. superciliosus (White-eyebrowed Wood Swallow).	6	18	62
LANIIDÆ.			
Lanius, whole genus	19	13·6	78
L. collurio (Red-backed Shrike)	13	12	49
L. excubitor (Great Grey ,,)	5	4·6	21
L. lahtora (Indian ,, ,,)	1	78	78
Laniarius quadricolor (Four-coloured Shrike).	1	3	3
Cochoa viridis (Green Cochoa)	1	34	34
AMPELIDÆ.			
Ampelis cedrorum (Cedar Bird)	1	14	14
A. garrulus (Waxwing)	18	8·5	39
MUSCICAPIDÆ.			
Muscicapa atricapilla (Pied Flycatcher).	1	3	3
HIRUNDINIDÆ.			
Hirundo rustica (Swallow)..............	2	1	2
NECTARINIIDÆ.			
Zosterops, whole genus	18	21	87
Z. dorsalis (Grey-backed White-eye) .	2	24	46
Z. lateralis (Lateral ,,) .	12	11	25
Z. palpebrosus (Indian ,,) .	2	70	87
Z. simplex (Chinese ,,) .	2	29·5	58

MELIPHAGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Prosthemadera novæ-zealandiæ (Poë Honey-eater).	19	14	58
Myzantha garrula (Garrulous ,,).	1	9	9
Anthornis melanura (Black-tailed Flower-bird).	5	6·4	13
Xanthomyza phrygia (Warty-faced Honey-eater).	5	19	37
Entomyza cyanotis (Blue-faced Honey-eater).	4	5	12
CŒREBIDÆ.			
Cœreba cyanea (Yellow-winged Sugar-bird).	26	24·4	92
Dacnis cyana (Blue Sugar-bird) ……	4	11·5	18
Chlorophonia spiza (Black-headed Sugar-bird).	2	42·5	84
TANAGRIDÆ.			
Chlorophonia viridis (All-green Tanager).	6	3	4
Euphonia, whole genus ………………	41	12·5	39
E. chlorotica (Greenish Tanager) ……	1	1	1
E. flavifrons (Yellow-fronted Tanager).	2	16	30
E. laniirostris (Thick-billed ,,).	9	11	39
E. nigricollis (Black-necked ,,).	4	7·5	10
E. pectoralis (Pectoral ,,).	1	8	8
E. sclateri (Sclater's ,,).	1	1	1
E. violacea (Violet ,,).	23	15	34
Hypophæa chalybea (Lead-coloured Tanager).	1	11	11
Tanagrella cyanomelæna (Blue & Black Tanager).	2	14·5	15
T. velia (Red-bellied Tanager) ………	1	2	2
Calliste, whole genus …………………	32	11·5	39
C. brasiliensis (Brazilian Tanager) …	3	5	8
C. fastuosa (Superb Tanager) ……	13	15	39
C. festiva (Festive ,,) ……	3	4	4
C. melanota (Black-shouldered Tanager).	2	5	6
C. tricolor (Green-headed Tanager)…	11	11·8	33
Tanagra, whole genus ………………	24	16	70
T. cana (Silver-blue Tanager) ………	3	12	23
T. cyanoptera (Blue-shouldered Tanager)	7	18	49
T. palmarum (Palm Tanager) ………	5	11	33
T. sayaca (Sayacu ,,) ………	2	7	11
T. striata (Striated ,,) ………	7	21	70
Stephanophorus leucocephalus (White-capped Tanager)	2	3	4
Tachyphonus coronatus (Crowned Tanager).	1	8	8
T. melaleucus (Black Tanager) ………	8	22	47

TANAGRIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pyranga saira (Saira Tanager)	2	3·5	5
Rhamphocœlus brasilius (Brazilian Tanager).	13	46	88
Cissopis leveriana (Magpie Tanager) .	9	30	87
Saltator aurantiirostris (Orange-bellied Tanager).	1	75	75
S. magnus (Great Tanager)	1	3	3
S. similis (Allied ,,)	2	10	19
Orchesticus ater (Black-headed Tanager).	1	66	66
PLOCEIDÆ.			
Estrelda, whole genus	176	28·5	98
E. amandava (Amaduvade Finch)......	30	31	98
E. bella (Beautiful Finch)	6	5	8
E. bichenovii (Bicheno's Finch).........	8	7·5	21
E. cinerea (Common Waxbill)......	21	45	93
E. cœrulescens (Cinereous ,,)	5	27	93
E. cyanogastra (Blue-breasted Waxbill)	6	25	57
E. dufresnii (Dufresne's ,,)	10	23·7	63
E. formosa (Green ,,)	16	20	44
E. granatina (Grenadier ,,)	1	38	38
E. melpoda (Orange-cheeked ,,)	17	32	84
E. phœnicotis (Crimson-eared ,,)	8	21	34
E. phaëton (Crimson ,,)	6	14·5	38
E. rubriventris (Red-bellied ,,)	21	37	88
E. squamifrons (Scaly-fronted ,,)	4	9	12
E. subflava (Zebra ,,)	7	35	84
E. temporalis (Australian ,,)	10	23·9	74
Spermestes, whole genus	26	30	85
S. cucullata (Hooded Finch)	10	30	47
S. fringilloides (Pied Grass-Finch) ...	12	21	80
S. nana (Dwarf Finch)	4	55	85
Pytelia, whole genus	9	14·5	43
P. citerior (Western Melba Waxbill)...	1	1	1
P. phœnicoptera (Crimson-winged Waxbill).	6	12	29
P. wieneri (Wiener's Finch)	2	27·5	43
Amadina, whole genus	78	27	99
A. bicolor (Cape Palmas Finch).........	3	33	58
A. castanotis (Chestnut-eared Finch)	27	42	99
A. erythrocephala (Red-headed ,,)	7	21	38
A. fasciata (Cut-throat ,,)	5	24	42
A. fringilloides (Fringillid ,,)	1	22	22
A. lathami (Spotted-sided ,,)	23	14	52
A. modesta (Modest ,,)	12	22	67
Munia, whole genus	75	37·5	123
M. ferruginea (Javan Maja Finch) ...	1	61	61

PLOCEIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Munia maja (Maja Finch) ...	6	56	101
M. malabarica (Indian Silver-bill) ...	18	30	115
M. malacca (Black-headed Finch)......	6	30	109
M. nisoria (Bar-breasted ,,)......	11	54	123
M. punctularia (Nutmeg-Bird)	10	41	75
M. rubro-nigra (Chestnut-bellied Finch).	12	33	89
M. striata (Striated Finch)	5	30	57
M. topela (Topela ,,)	6	21	82
Poëphila, whole genus....................	53	23	82
P. acuticauda (Long-tailed Grass-Finch)	5	22	67
P. cincta (Banded ,, ,,)	21	20	74
P. gouldiæ (Gouldian ,, ,,)	14	27	82
P. mirabilis (Beautiful ,, ,,)	13	22·7	79
Donacola castaneothorax (Chestnut-breasted Finch).	16	20	44
D. pectoralis (White-breasted ,,)	2	8·6	15
Padda oryzivora (Java Sparrow)	14	54	159
Erythrura prasina (Fire-tailed Finch)	4	10	12
E. psittacea (Parrot ,,)	4	7·5	11
Vidua, whole genus.......................	47	25	199
V. albonotata (White-marked Whydah Bird).	1	13	13
V. ardens (Red-chested Whydah Bird)	2	27·5	28
V. paradisea (Paradise ,, ,,)	32	28	199
V. principalis (Pin-tailed ,, ,,)	12	16	81
Chera progne (Long-tailed Weaver-bird).	4	13	17
Hypochera nitens (Shining Weaver-bird)	5	72	124
Coliopasser macrurus (Yellow-backed Whydah Bird).	4	85	239
Urobrachya, whole genus	9	23	107
U. albonotata (White-winged Whydah Bird).	5	35	107
U. axillaris (Red-shouldered Weaver-bird).	2	45	71
U. bocagii (Orange-shouldered Weaver-bird).	2	21·5	26
Euplectes, whole genus	70	40	131
E. afer (Black-bellied Weaver-bird).	6	31	106
E. capensis (Yellow-shouldered Weaver-bird).	9	60	98
E. flammiceps (Crimson-crowned Weaver-bird).	14	71	131
E. nigriventris (Black-chested ,,)	2	36·5	60
E. oryx (Grenadier ,,)	39	26	119
Pyromelana aurea (Golden-backed Weaver-bird).	4	22	57

PLOCEIDÆ (*cont*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pyromelana franciscana (Scarlet Weaver-bird.)	2	62	85
Foudia erythrops (Red-faced ,, ,,)	8	48	102
F. madagascariensis (Red-headed Weaver-bird).	12	31	64
Pyrenestes albifrons (White-fronted Weaver-bird).	2	71	83
Spermospiza hœmatina (Blue-beaked Weaver-bird).	3	27	55
S. guttata (Bright-spotted ,, ,,)	2	40·5	45
Quelea, whole genus	38	51	130
Q. occidentalis (Black-cheeked Weaver-bird.)	3	63	78
Q. russi (Russ's Weaver-bird)	6	45	121
Q. sanguinirostris (Red-beaked ,,)	29	48	130
Ploceus, whole genus	16	28	60
P. atrigula (Black-throated Weaver-bird).	3	18	28
P. bengalensis (Bengal Weaver-bird)	3	15	29
P. manyar (Manyar ,, ,,)	10	34	60
Heterhyphantes melanogaster (Black-chested Weaver-bird).	1	122	122
Sitagra luteola (Yellowish ,, ,,)	2	67	71
Hyphantornis, whole genus	46	48	189
H. brachyptera (Short-winged Weaver-bird).	1	10	10
H. capensis (Olive Weaver-bird)	9	35	124
H. castaneofuscus (Chestnut-backed Weaver-bird).	3	23	38
H. nigriceps (Black-headed ,, ,,)	2	55	110
H. personata (Masked ,, ,,)	5	57	138
H. superciliosus (Eye-browed ,, ,,)	1	46	46
H. textor (Rufous-necked ,, ,,)	17	59	189
H. velatus (Black-fronted ,, ,,)	8	46	83
Textor alector (Ox-bird)	1	70	70
FRINGILLIDÆ.			
Cyanospiza ciris (Nonpareil Finch) ...	13	20·8	56
C. cyanea (Indigo-bird)	7	24	45
Phonipara canora (Melodious Finch)...	5	33	43
P. olivacea (Olive Finch)	2	19	27
Paroaria, whole genus	38	38·9	101
P. capitata (Yellow-billed Cardinal)...	6	13·5	30
P. cucullata (Red-crested ,,)...	25	44	101
P. larvata (Red-headed ,,)...	7	40	76
Gubernatrix cristatellus (Black-crested Cardinal).	11	34	108
Diuca grisea (Diuca Finch)	11	43	189

FRINGILLIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months,
Phrygilus, whole genus	4	31	86
P. alaudinus (Alaudine Finch)	1	86	86
P. fruticeti (Orchard ,,)	1	15	15
P. gayi (Gay's ,,)	2	27	37
Guiraca, whole genus	12	21	71
G. cærulea (Blue Grosbeak)	2	26	35
G. cyanea (Brazilian Blue Grosbeak)...	8	19	71
G. parellina (Lazuline Finch)	2	25	45
Hedymeles ludovicianus (Rose-breasted Grosbeak).	2	7	11
Pheucticus chrysogaster (Yellow-bellied Grosbeak).	1	37	37
Cardinalis virginianus (Cardinal ,,)	21	31	83
Oryzoborus crassirostris (Thick-billed Seed-Finch).	1	53	53
O. torridus (Tropical ,, ,,)	7	21	49
Coryphospingus cristatus (Red-creasted Finch).	8	47	123
C. pileatus (Pileated Finch)	5	14	40
Spermophila, whole genus	50	43·5	127
S. albogularis (White-throated Finch)	5	83	123
S. cærulescens (Bluish ,,)	7	43	78
S. collaria (Collared ,,)	2	109	127
S. euleri (Euler's ,,)	2	2	2
S. gutturalis (Guttural ,,)	2	30·5	34
S. hypoleuca (Half-white ,,)	2	16·5	33
S. lineata (Lineated ,,)	2	66	88
S. lineola (Lined ,,)	18	36	110
S. nigro-aurantia (Reddish ,,)	3	45	101
S. plumbea (Plumbeous ,,)	6	36	85
S. torqueola (Black-banded ,,)	1	3	3
Passer, whole genus	25	22	135
P. alario (Alario Sparrow)	12	8	16
P. arcuatus (Cape ,,)	1	21	21
P. diffusus (Black-breasted Sparrow)...	1	19	19
P. luteus (Yellow ,,)...	5	40	124
P. montanus (Tree ,,)...	2	16	19
P. salicicola (Spanish ,,)...	1	38	38
P. simplex (Grey-headed ,,)...	3	45	135
Petronia petronella (Yellow-throated Rock-Sparrow).	7	9·7	17
P. stulta (Rock-Sparrow)	2	46	91
Coccothraustes, whole genus	31	22·5	92
C. melanurus (Black-tailed Hawfinch)	8	34	74
C. personatus (Masked ,,)	2	12·5	24
C. vulgaris (Hawfinch)	21	19	92
Mycerobas melanoxanthus (Black and Yellow Hawfinch).	1	44	44
Ligurinus chloris (Greenfinch)	2	38	66

Fringillidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Ligurinus sinicus (Japanese Greenfinch).	5	27	85
Montifringilla nivalis (Snow-Finch) ...	2	21·5	37
Fringilla, whole genus	43	36	142
F. cœlebs (Chaffinch)	7	33	142
F. kawarahiba (Kawarahiba Finch) ...	2	42	55
F. linaria (Mealy Redpoll)	1	89	89
F. montifringilla (Brambling)	22	45	105
F. spodiogenia (Alpine Chaffinch)	2	23	24
F. teydea (Teydean ,,)	5	10	22
F. tintillon (Tintillon ,,)	4	23	60
Carduelis elegans (Goldfinch)	21	24	57
C. orientalis (Eastern ,,)	3	18	43
Chrysomitris, whole genus	33	13	90
C. barbatus (Black-chinned Siskin) ...	5	1·4	4
C. spinoides (Indian ,,) ...	1	90	90
C. spinus (Siskin)	23	12	74
C. tristis (American Siskin)	3	11	32
C. yarrelli (Yarrell's ,,)	1	24	24
Sycalis, whole genus	32	27	90
S. arvensis (Field Saffron Finch)	2	33	52
S. flaveola (,, ,,)	22	24	90
S. luteola (Yellowish ,,)	8	31	80
Crithagra, whole genus	34	24	90
C. albogularis (White-throated Seed-eater).	6	10	30
C. butyracea (Yellow Seed-eater)	10	22	90
C. chrysopyga (Yellow-rumped ,,)	13	38	80
C. musicus (Singing ,,)	2	17	24
C. sulphurata (Sulphury ,,)	3	2	4
Serinus, whole genus	18	15	52
S. angolensis (Angolan Serin)	1	22	22
S. canarius (Canary).....................	12	14	52
S. canicollis (Grey-necked Serin)	1	20	20
S. hortulanus (Serin)	3	10·3	24
S. tottus (Brown Canary)	1	27	27
Linota, whole genus	28	21	92
L. cannabina (Linnet)	3	14	24
L. flavirostris (Twite)	4	39	92
L. rufescens (Lesser Redpoll)...........	21	18·5	74
Carpodacus erythrinus (Ruddy Finch)	13	28	79
C. hæmorrhous (Blood-stained ,,)	4	25	49
Erythrospiza githaginea (Rosy Bullfinch)	6	27	52
Pyrrhula europæa (Bullfinch)...........	8	12	41
P. rubicilla (Siberian Bullfinch)	7	12	23
Pinicola enucleator (Pine-Grosbeak) ...	10	13	44
Loxia, whole genus.......................	29	8	39
L. pityopsittacus (Parrot Crossbill) ...	3	24	39
L. leucoptera (White-winged Crossbill)	4	12	37

FRINGILLIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Loxia curvirostra (Common Crossbill) .	21	6	24
L. bifasciata (European White-winged Crossbill).	1	5	5
Plectrophenax nivalis (Snow Bunting)	63	11·5	65
Calcarius lapponicus (Lapland ,,)	4	18	30
Emberiza, whole genus	86	36	165
E. aureola (Yellow-breasted Bunting)	4	85·5	115
E. cia (Meadow ,,)	1	7	7
E. ciopsis (Bonaparte's ,,)	1	11	11
E. cirlus (Cirl ,,)	17	21	63
E. citrinella (Yellow Hammer)	5	27	77
E. chrysophrys (Yellow-browed Bunting)	2	53	86
E. hortulana (Ortolan ,,)	9	25	75
E. luteola (Red-headed ,,)	11	63	165
E. melanocephala (Black-headed ,,)	7	52	141
E. miliaria (Corn ,,)	6	45	123
E. rutila (Red-backed ,,)	5	50	149
E. schœniclus (Reed ,,)	16	20	62
E. striolata (Striolated ,,)	2	15	21
Euspiza americana (American ,,)	3	15	23
Fringillaria saharæ (Sahara ,,)	2	25·5	38
Melophus melanicterus (Crested Black Bunting).	2	12·5	24
Zonotrichia albicollis (White-throated Song Sparrow).	2	73	97
Z. pileata (Pileated ,, ,,)	13	17	42
Junco hyemalis (Snow-bird)	7	17	72
Spizella socialis (Chipping Sparrow) ...	1	8	8
Pipilo erythrophthalmus (Red-eyed Ground-Finch).	4	25	45
ICTERIDÆ.			
Ostinops decumanus (Crested Hangnest).	2	21	28
Cassicus hæmatorrhous (Red-rumped Hangnest).	2	41	57
C. persicus (Yellow ,,)	11	46	102
Icterus, whole genus	31	27	110
I. abeillæi (Black-sided Hangnest) ...	1	30	30
I. baltimore (Baltimore ,,) ...	5	14	38
I. chrysocephalus (Yellow-crowned Tropical Hangnest).	1	66	66
I. jamaici (Brazilian Hangnest)	7	40	80
I. spurius (Orchard ,,)	6	17	31
I. tibialis (Yellow-shouldered Hangnest).	3	27	45
I. vulgaris (Common Hangnest)	8	27	110
Dolichonyx oryzivora (American Rice-bird).	1	3	3

ICTERIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Molothrus, whole genus	25	65	145
M. badius (Bay Cow-bird)	5	67	145
M. bonariensis (Silky ,,)	18	65	135
M. purpurascens (Purple ,,)	2	52	71
Agelæus, whole genus	8	44	94
A. frontalis (Chestnut-fronted Troupial).	1	16	16
A. phœniceus (Red-shouldered Starling)	5	54	94
A. ruficapillus (Red-headed Marsh-bird)	2	33	65
Xanthocephalus icterocephalus (Yellow-headed Troupial).	11	47	123
Xanthosomus flavus (Yellow ,,)	3	53	98
Amblyrhamphus holosericeus (Silky Hangnest).	7	50	122
Pseudoleistes virescens (Dark-green Maize-eater).	5	26	55
Sturnella defilippi (De Filippi's Meadow-Starling).	18	16	39
S. ludoviciana (Louisianian ,, ,,)	2	10·5	16
Curæus aterrimus (Chilian Starling)...	1	24	24
Lampropsar dives (Rich-black Troupial).	1	2	2
Quiscalus lugubris (Black ,,)	1	2	2
Q. versicolor (Changeable ,,)	9	10	31
Aphobus chopi (Chopi Starling)	3	62	102
STURNIDÆ.			
Lamprocolius auratus (Purple-headed Glossy Starling).	3	141	155
L. chalybeus (Green ,, ,,)	5	71	150
Lamprotornis æneus (Long-tailed Glossy Starling).	6	44	77
Sturnus menzbieri (Indian Starling)	2	25	26
S. vulgaris (Common ,,)	9	26	58
Sturnopastor contra (Pied Mynah) ...	3	59	107
Acridotheres, whole genus	25	44	145
A. cristatellus (Chinese Mynah)	6	34	62
A. fuscus (Brown ,,)	6	42	145
A. ginginianus (Indian ,,)	1	41	41
A. mahrattensis (Southern Brown Mynah).	2	58	97
A. tristis (Common Mynah)	10	47·8	117
Poliopsar, whole genus	8	30	97
P. andamanensis (Andaman Starling).	2	20·5	38
P. blythi (Blyth's ,,)	1	23	23
P. malabaricus (Malabar Mynah) ...	5	33	97
Temenuchus pagodarum (Black-headed Mynah).	1	13	13

Sturnidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pastor roseus (Rose-coloured Pastor)	24	34	97
Gracupica nigricollis (Black-necked Grackle).	1	16	16
Dilophus carunculatus (Wattled Starling).	6	42	73
Gracula, whole genus	39	30	124
G. intermedia (Larger Hill Mynah)	20	33	124
G. javanensis (Javan Mynah)	1	77	77
G. religiosa (Small Hill Mynah)	18	22	61
Ptilonorhynchidæ.			
Ptilonorhynchus smithi (Green Bower Bird).	1	19	19
P. violaceus (Silky Bower Bird)	35	30	115
Chlamydodera maculata (Spotted Bower Bird).	5	40	68
Paradiseidæ.			
Paradisea minor (Lesser Bird of Paradise).	5	30	65
P. rubra (Red Bird of Paradise)	1	4	4
Ptilorhis paradisea (Rifle-bird)	1	46	46
Seleucides nigricans (Twelve-wired Bird of Paradise).	1	11	11
Manucodia chalybea (Green Manucode)	1	12	12
Corvidæ.			
Corvus, whole genus	140	24·6	133
C. americanus (American Crow)	1	51	51
C. australis (Australian ,,)	7	32	82
C. capellanus (Chaplain ,,)	23	22	89
C. corax (Raven)	31	11	47
C. cornix (Hooded Crow)	14	35	99
C. corone (Carrion ,,)	12	15	46
C. culminatus (Long-billed Crow)	2	20	36
C. daüricus (Black-and-white Jackdaw).	1	20	20
C. frugilegus (Rook)	13	10	27
C. monedula (Jackdaw)	15	39	89
C. scapulatus (White-necked Crow)	10	21	113
C. splendens (Indian ,,)	11	38	133
Corvultur albicollis (White-necked Raven).	1	18	18
Nucifraga caryocatactes (Nutcracker)	6	27	93
Pica, whole genus	19	51	131
P. bootanensis (Himalayan Magpie)	1	6	6
P. mauritanica (Moorish ,,)	1	9	9
P. rustica (Magpie)	15	54	131
P. sericea (Chinese Magpie)	2	69	83

Corvidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cyanopolius cooki (Spanish Blue Magpie).	36	24	75
C. cyanus (Chinese Blue Magpie)	8	31·5	84
Garrulus glandarius (Jay)	20	12·8	41
G. lanceolatus (Lanceolated Jay)	5	46	80
Cyanocitta, whole genus	17	25	94
C. coronata (Crowned Jay)	2	4·5	6
C. cristata (Blue ,,)	10	20	54
C. melanocyanea (Guatemala Blue Jay).	1	16	16
C. yucatanica (Yucatan ,, ,,)	4	51	94
Cyanocorax, whole genus	62	12·5	77
C. cyanomelas (Black-headed Jay)	1	3	3
C. luxuosus (Mexican ,,)	2	19·5	29
C. cyanopogon (Blue-bearded ,,)	40	11·5	77
C. pileatus (Pileated ,,)	19	14	32
Calocitta formosa (Swainson's Long-tailed Jay),	3	16	29
Urocissa, whole genus	14	27	89
U. flavirostris (Yellow-billed Blue Pie)	2	17·5	18
U. magnirostris (Siamese ,, ,,)	8	15	45
U. occipitalis (Occipital ,, ,,)	2	17	25
U. sinensis (Chinese ,, ,,)	2	87	89
Cissa venatoria (Hunting Crow)	6	21	56
Dendrocitta, whole genus	14	27	109
D. himalayensis (Himalayan Tree Pie)	4	22·5	40
D. sinensis (Chinese ,, ,,)	5	38	109
D. vagabunda (Wandering ,, ,,)	5	21	30
Ptilostomus senegalensis (Piapec)	2	32·5	41
Pyrrhocorax alpinus (Alpine Chough).	10	40·6	87
P. graculus (Chough)	5	41·4	94
Corcorax melanorhamphus (White-winged Chough).	9	23·5	106
Heterolocha gouldi (Huia Bird)	2	19	21
Strepera, whole genus	9	28	98
S. anaphonensis (Grey Crow-Shrike)	2	15	21
S. graculina (Pied ,, ,,)	6	34	98
S. fuliginosa (Sooty ,, ,,)	1	15	15
Gymnorhina leuconota (White-backed Piping Crow).	26	42	120
G. tibicen (Black-backed ,, ,,)	6	40	102
Cracticus destructor (Long-billed Butcher Crow).	5	39	133
C. picatus (Pied ,, ,,)	1	57	57
Alaudidæ.			
Alauda, whole genus	18	26	97
A. arborea (Wood-lark)	5	26	44
A. arvensis (Sky-lark)	3	33	55

Alaudidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Alauda cœlivox (Sweet-voiced Lark) ...	1	13	13
A. crassirostris (Thick-billed ,,) ...	1	24	24
A. cristata (Crested ,,) ...	7	15	86
A. gulgula (Indian Sky-lark) ...	1	97	97
Calandrella bœtica (Andalusian Short-toed Lark).	7	14	19
C. brachydactyla (Short-toed Lark) ...	2	28	47
Mirafra affinis (Meadow Bush-Lark) .	1	14	14
M. cantillans (Pale Indian ,, ,,) .	1	1·5	2
Melanocorypha, whole genus	20	11·5	81
M. calandra (Calandra Lark)	10	14·6	81
M. mongolica (Chinese ,,)	2	17	32
M. yeltoniensis (Black ,,)	8	6·5	14
Rhamphocorys clotbeyi (Clotbey's Lark).	3	13	19
Pyrrhulauda verticalis (White-headed Bullfinch Lark).	6	16	35
Otocorys alpestris (Shore Lark)	12	25·6	61
O. bilopha (Algerian ,, ,,)	2	9·5	10
Pittidæ.			
Pitta bengalensis (Bengal Pitta)	1	22·5	24
P. strepitans (Noisy ,,)	4	11	29
Tyrannidæ.			
Machetornis rixosa (Short-winged Tyrant).	2	45·5	76
Tœnioptera nengeta (Pepoaza ,,)	1	5	5
Tyrannus melancholicus (Melancholy Tyrant).	1	67	67
T. pipiri (American King-bird)	1	12	12
Pitangus sulphuratus (Sulphury Tyrant).	21	34	104
Milvulus tyrannus (Fork-tailed ,,).	1	38	38
Cotingidæ.			
Chasmorhynchus niveus (Carunculated Chatterer).	1	53	53
C. nudicollis (Naked-throated Bell-bird).	18	21	49
Cotinga cincta (Banded Cotinga)	2	31	57
Rupicola crocea (Cock of the Rock) ...	8	8·5	20
Dendrocolaptidæ.			
Furnarius rufus (Red Oven-bird). ...	2	5·5	7
Menuridæ.			
Menura superba (Lyre-bird)	2	57·5	107

Summary of Passeres.

The first general question that requires consideration is the value of the data on which this summary is based. Passerine birds, except to those who pay special attention to them as pets, are relatively little individualized, and in a large collection it may well be that the history of one individual has been assigned by mistake to another individual. I cannot doubt that such mistakes have sometimes occurred, but I do not think that they have had much effect on the figures. The bias they would give would tend on the whole to lower the figures, for where there was a doubt as to a dead individual in the Keeper's mind, I find that he was disposed to assume that it was the oldest example. Moreover, if the figures be run through in detail, it will be found that very often high records occur in cases where the number of examples was so few that confusion of individuals cannot have taken place, whilst the period of 33 years covered is so long in proportion to the numbers in most cases, that probably this source of error is on the whole insignificant.

Mr. J. H. Gurney's remarkable paper * has already made plain that birds attain considerable ages, and the figures of maximum duration that I am able to record are in no case improbable. It is to be remembered that probably the vast majority of Passerines are received at the Gardens in an adult condition, that the age of an adult bird cannot be determined from inspection, and therefore the maximun durations recorded are in all cases below, and may be much below the potential longevity. Mr. Gurney gives the following as the oldest Passerines of which he had been able to obtain information: Raven 69 years, *Gymnorhina tibicen*, 26 years, Nightingale, 25 years, Skylark 24, Goldfinch 23, Grosbeak 21, Canary 20, Bullfinch 19, Weaver-bird 9; and he sets down 20 to 24 years as the possible limit of most Passerines in captivity. Amongst the Garden records, I may select the following:—Grey Struthidea, nearly 19 years, Paradise Whydah Bird, over 16 years, Diuca Finch, nearly 16 years, Glossy Starling and American Robin, about 13 years, Bay Cowbird, over 12 years, an Indian Crow over 11 years, a Bulbul 11 years, a Great Titmouse 9 years, a Lyre-bird, nearly 9 years. Mr. W. Chamberlain, F.Z.S., informs me that he bought an adult Cardinal (*Paroaria cucullata*) in 1874; that in 1896 it showed signs of age, chiefly difficulty with the autumn moult, and thickening of the scales of the legs; that it died in 1899, having lived in a cage for 25 years 4 months. It must be noticed that if size be taken into consideration, the ages bear no relation to the relative sizes of the birds which attained to them, and moreover that Passeres as a whole, in comparison with their size, live to much greater ages than is the case with mammals. This is entirely in accordance with the views of Metchnikoff, for Passerine birds in every case have the hind-gut and cæca very small in proportion to the total length and capacity of the alimentary canal. They digest rapidly, void their excreta at frequent intervals, and have very little opportunity for intestinal putrefaction.

---

* "The Comparative Ages to which Birds live," Ibis, 1899, p. 19.

With regard to viability, the record of Passerines is on the whole much better than in the case of mammals; that is to say, the maximum duration is frequently high and is much more nearly approached by the average duration. There are some notable exceptions. First, it is most striking that common British birds, like common British mammals, have very bad lives in captivity. I am inclined to put this down to the same kind of reasons. In the first place, it must frequently happen that birds are damaged by capture, or that many weak examples are taken, and these find their way quickly to the Gardens, there to die; whereas in the case of birds captured in remote regions, the deaths take place more frequently before arrival, and a selection of the hardier individuals is thus made automatically. The case would be more striking if I had included in the averages, the considerable number of birds that died without living for a month at the Gardens, a number relatively much greater in the case of common European and British forms. It seems, moreover, highly probable, that wild birds in this thickly populated country have survived in proportion to their development of a repulsion to the vicinity of man, a repulsion which only a small proportion of them, and that only gradually, can overcome in captivity. It is most remarkable how the average duration of such kinds as English Thrushes, Whinchats, Redstarts, Wheatears, Warblers, Tits, Nuthatches, Pipits, Shrikes, Linnets, Finches, Buntings, is from 12 months to 1 or 2 months, whilst that of their nearest foreign allies may be many times greater.

The viability, as shown by the average duration, has no constant relation to size. On the whole, soft-billed birds, such as the Tanagers, fed chiefly on fruit and prepared food, have been less successful than Finches and Weavers, and insectivorous birds have done less well than seed- and flesh-eaters. Nor is there any striking result to be obtained from consideration of the quarters assigned, for the vast majority of these Passerine birds have been kept under similar conditions. The Western Aviary, with open-air flights and heated retreats, has been their headquarters, although some of the small Finches, Tanagers, and Weaver Birds have been in cages in the Parrot House. The evidence points to Passerine birds having a good viability and a potential longevity, even in the case of the smallest, reaching well over twenty years. Although success has been greater than in the case of many mammals, I think that this is to be expected from the constitutions of these two sets of creatures, and that in proportion to their viability, the success in the case of Passerines is still far short of what might be achieved. Much has already been done to improve the access to air in the case of all the Passeres.

Capt. Flower's highest records are a Paradise Whydah Bird, still alive after 9 years' duration; an Amaduvade Finch after 7 years, a Black-headed Chestnut-Finch after 9 years, a Java Sparrow of over 10 years' duration, and a Red-crested Cardinal of over 8 years' duration. It is noteworthy that these figures are comparable with my records and relate to species or genera which have had long-lived examples here. Actually our records are higher, but the number of individuals amongst which they occurred is greater.

PICARIÆ.

CAPRIMULGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Caprimulgus europæus (Nightjar)	4	4	7

I have omitted a number of cases that lived for less than a month, but this is only another instance of failure with common European birds.

PICIDÆ.			
Dendrocopus major (Greater Spotted Woodpecker).	16	9·8	33
Centurus tricolor (Banded ,,).	1	14	14
Melanerpes erythrocephalum (Red-headed Woodpecker).	1	2	2
Leuconerpes candidus (White-headed Woodpecker).	2	12	16
Gecinus viridis (Green Woodpecker) ...	9	0	0
Colaptes auratus (Golden-winged Woodpecker).	8	23	54
Iynx torquilla (Wryneck)	5	0	0

Amongst the Woodpeckers and Wrynecks there is again complete failure with British birds, whilst the other figures would appear to show a low viability for the birds of this group, appearing both in the average and maximum durations.

COLIIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Colius, whole genus	14	35	91
C. capensis (Cape Coly)	10	34·4	91
C. castanotus (Chestnut-backed Coly)...	2	8·5	9
C. erythromelon (Red-cheeked ,,)...	1	66	66
C. nigricollis (Black-necked ,,)...	1	65	65

These small, chiefly frugivorous birds, have in proportion to their size a good maximum and average duration, and must be inferred to have a good viability. It is interesting to note that the whole length of the intestines is remarkably short, although capacious, and there can be little opportunity for intestinal putrefaction. In the period under consideration the Colies were kept in the Parrot House, without access to open air.

ALCEDINIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Alcedo ispida (Kingfisher)	27	4	24
Halcyon, whole genus	10	23	44
H. chloris (Green-headed Kingfisher) .	1	28	28
H. sanctus (Sacred ,,) .	5	17	32
H. smyrnensis (White-breasted Kingfisher)	1	26	26
H. vagans (New Zealand ,,)	3	30	44
Dacelo, whole genus	54	25·5	84
D. cervina (Buff Laughing Kingfisher).	2	28	34
D. gigantea (,, ,,).	51	25	84
D. leachi (Leach's ,, ,,).	1	58	58

In the usual fashion, the failure with the Common Kingfisher has been very great. The other Kingfishers, in proportion to their size, show poor maximum and average durations, and these birds must be regarded as of relatively low viability. Although there are no cæca, the hind-gut is relatively long and capacious. Mr. Gurney cites, from the Rotterdam Gardens, an instance of a Laughing Kingfisher having lived for 11 years. Our highest regard is 7 years. In the period in question these birds have been kept in the Western Aviary, with heated interior but access to open air.

BUCEROTIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Bucorvus abyssinicus (Ground Hornbill)	7	32	146
B. cafer (South African ,, ,,)	1	64	64
Buceros lunatus (Lunated Hornbill) ...	1	77	77
B. rhinoceros (Rhinoceros ,,) ...	6	24	75
Dichoceros bicornis (Concave-casqued Hornbill)	10	56	167
Anthracoceros, whole genus	9	24	51
A. coronatus (Crowned Hornbill).........	4	25	48
A. malayanus (White-billed Hornbill) .	1	10	10
A. malabaricus (Indian Pied ,,) .	4	26	51
Cranorrhinus corrugatus (Wrinkled-billed Hornbill)	1	1	1
Aceros nepalensis (Nepalese ,,)	2	5·5	10
Ceratogymna elata (Elate ,,)	5	48	138
Sphagolobus atratus (Black ,,)	5	40	121
Bycanistes subcylindricus (Subcylindrical Hornbill).	2	59	94
Rhytidoceros plicatus (Plicated ,,) + *undulatus*.	6	14·5	33
Toccus erythrorhynchus (Red-billed ,,)	4	33	61
T. melanoleucus (Black and White ,,)	2	47	58

The Hornbills are omnivorous, rather large birds, and the record of maximum duration of 14 years for a Concave-casqued Hornbill is by no means unexpectedly high. The relation of average duration to maximum duration varies but is on the whole good, showing a fairly high viability. These birds have been kept for the most part in a large aviary with heated retreats but access to the outer air.

UPUPIDÆ.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Upupa epops (Hoopoe)	7	17	29

The maximum and average durations show low viability.

MOMOTIDÆ.

Momotus brasiliensis (Brazilian Motmot)	1	74	74
M. subrufescens (Cartagenian ,,)	2	98	121

The numbers of individuals are very small but would appear to show a high viability for these omnivorous birds, which have been kept in a heated aviary with open-air flight-cages.

MEROPIDÆ.

Merops apiaster (Common Bee-eater)	2	12	13

The very poor success with Bee-eaters is no doubt associated with the difficulty of feeding them.

CORACIIDÆ.

Coracias affinis (Allied Roller)	1	21	21
C. garrulus (Common ,,)	6	6·5	10

The difficulty with these omnivorous but largely insectivorous birds is probably the provision of suitable food.

PODARGIDÆ.

Podargus cuvieri (Cuvier's Podargus)	4	12	32

There seems no reason except low viability to account for the absence of success with this hardy-looking omnivorous bird.

STEATORNITHIDÆ.

Steatornis caripensis (Oil-bird)	1	1	1

No just inference can be drawn from a single example.

RHAMPHASTIDÆ.

	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Rhamphastos, whole genus	59	35	143
R. ariel (Ariel Toucan)	27	24	101
R. brevicarinatus (Short-billed Toucan)	2	91	108
R. carinatus (Sulphur-breasted ,,)	7	26	58
R. cuvieri (Cuvier's ,,)	2	5	8
R. dicolorus (Green-billed ,,)	5	54	143

RHAMPHASTIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Rhamphastos erythrorhynchus (Red-billed Toucan)	3	20	35
R. tocard (Doubtful Toucan)	2	67	91
R. toco (Toco Toucan)	9	44	93
R. vitellinus (Sulphur-and-white-breasted Toucan)	2	96·5	105
Pteroglossus, whole genus	20	29	87
P. inscriptus (Lettered Aracari)	5	20	30
P. torquatus (Banded ,,)	6	35	71
P. wiedi (Maximilian's ,,)	9	32	87
Selenidera maculirostris (Spot-billed Toucanet).	2	20	25

The Toucans and Aracaris are fruit-eating but partly omnivorous and flesh-eating birds, with simple intestines, the hind-gut being relatively short and not very capacious. Their viability as shown by maximum and average durations is relatively good. In the period in question they were kept in large cages in a warmed house, without access to the open air.

CAPITONIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Megalæma, whole genus	11	40	122
M. asiatica (Blue-cheeked Barbet) ...	6	42	104
M. hodgsoni (Hodgson's ,,) ...	1	4	4
M. virens (Great ,,) ...	4	46	122

The Barbets have an almost omnivorous diet and have short intestines, the hind-gut being relatively short and uncapacious. Their viability as shown by maximum and average durations is good, and in the period covered they were kept in cages in a warmed house without access to the open air.

CUCULIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cuculus canorus (Cuckoo)	21	7	38
Eudynamis orientalis (Black Cuckoo)	5	19	41
E. taitensis (Long-tailed ,,)	1	3	3
Centropus, whole genus	6	20·5	37
C. phasianus (Pheasant Coucal)	1	19	19
C. rufipennis (Indian ,,)	3	22	37
C. senegalensis (Senegal ,,)	2	18·5	19
Crotophaga ani (Ani)	5	6	26
Guira piririgua (Guira Cuckoo)	23	25	55

The Cuckoos are insectivorous and omnivorous birds with relatively capacious hind-guts. Their viability as shown by the maximum and average durations is low, but as is usual the failure has been most complete in the case of the Common Cuckoo. These birds have been kept under different conditions, sometimes with, and sometimes without, access to open air.

MUSOPHAGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Turacus, whole genus	53	17·8	93
T. buffoni (Buffon's Touracou)	5	13	20
T. corythaix (White-crested Touracou).	9	28	93
T. livingstoni (Livingstone's ,,).	2	11	14
T. macrorhynchus (Great-billed ,,).	4	19	33
T. persus (Senegal ,,).	32	15	60
T. schalowi (Benguela ,,).	1	37	37
Gallirex chlorochlamys (Green-necked Touracou).	5	24	45
G. porphyreolopha (Purple-crested Touracou).	1	19	19
Musophaga violacea (Violaceous Plantain-eater).	7	17	44

The Touracous and Plantain-eaters are frugivorous and omnivorous birds with relatively simple intestines, the hind-gut being reduced. Their viability, as shown by maximum and average durations, is not good but surpasses that of the Cuckoos. They have been kept under varying conditions, always with artificial heat, but in some cases with access to the open air.

Summary of Picariæ.

Picarian birds form a heterogeneous group, united by no certain or close bands of affinity, and it is not surprising that their relative viabilities and longevities do not correspond with their gradations of size in any close fashion, although there is evidence of such a general relation. The maximum duration recorded is nearly 14 years for a Hornbill; then come a Toucan with nearly 12 years, a Motmot and Barbet with 10 years, a Touracou with nearly 8 years, and a Kingfisher with 7 years. The conditions under which these birds were kept during the period covered, have not differed much. In the vast majority of cases they were kept in houses or aviaries with artificial heat, but in some instances there was access, at least occasionally, to open-air flight-cages. I am unable, however, to draw any clear inference with regard to the effect of the mode of housing from the facts at my disposal. The very marked differences in viability exhibited, I think, must depend largely on real constitutional differences between the different suborders. The diet of the whole set tends to be mixed, with a strong leaning towards carnivorous or insectivorous character. The character of the alimentary tract varies considerably within the assemblage, and I think a marked correlation can be traced between the kind of gut and the viability. The Caprimulgidæ, Meropidæ, Coraciidæ, and Cuculidæ have all relatively capacious hind-guts and cæca, and in all these the average duration is low, generally under a year, whilst the maximum duration is never high. The Musophagidæ are generally regarded as being closely allied to the Cuckoos; they have no cæca and a relatively uncapacious hind-gut, and their average duration is considerably over a year, whilst examples have lived over 7 years. The Upupidæ have no cæca but a relatively capacious hind-gut, and have a low viability. The Picidæ and Alcedinidæ have no cæca; the hind-gut of the Woodpeckers is certainly not specially capacious, and they must be regarded as exceptions to the generalization; the Kingfishers are rather better in viability, but in the family as a whole it is not good. On the other hand, the Musophagidæ, as I have already mentioned, the Momotidæ, the Coliidæ, the Capitonidæ, the Rhamphastidæ, and Bucerotidæ are all devoid of functional cæca, have relatively short and uncapacious hind-guts, and show amongst Picarian birds the highest average and maximum durations. The group appears to furnish considerable evidence for Metchnikoff's generalization as to the relation between long duration of life and the absence of opportunity for intestinal putrefaction.

It is interesting to note that Capt. Flower's only high Picarian record, that of a Coly still alive after 5 years' duration, is in my records surpassed by three different species of the same genus.

STRIGES.

STRIGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Strix flammea (Barn Owl)	67	17·4	60
Phodilus badius (Bay Wood Owl)	1	50	50
ASIONIDÆ.			
Asio, whole genus	77	10	30
A. brachyotus (Short-eared Owl)	22	11	30
A. mexicanus (Mexican Eared Owl)	2	15	15
A. otus (Long-eared Owl)	53	4	26
Syrnium, whole genus	71	21	134
S. aluco (Tawny Owl)	60	18	47
S. indranee (Indranee ,,)	4	55	134
S. nebulosum (Barred ,,)	1	63	63
S. nuchale (Sharp's Wood-Owl)	2	20	28
S. sinense (Pagoda Owl)	1	50	50
S. personata (Spectacled ,,)	1	12	12
S. uralense (Ural ,,)	1	2	3
S. woodfordi (Woodford's ,,)	1	8	8
Bubo, whole genus	88	32	111
B. ascalaphus (Savigny's Eagle-Owl)	1	34	34
B. bengalensis (Bengal ,,)	3	32	64
B. blakistoni (Blakiston's ,,)	2	16	23
B. coromandus (Coromandel ,,)	1	29	29
B. lacteus (Milky ,,)	2	58	99
B. maculosus (Spotted ,,)	17	27	59
B. magellanicus (Magellanic ,,)	1	7	7
B. maximus (Great ,,)	38	28	81

ASIONIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Bubo nepalensis (Nepal Eagle-Owl)...	1	108	108
B. orientalis (Oriental ,,)...	1	83	83
B. poensis (Fraser's ,,)...	3	45	107
B. virginianus (Virginian ,,)...	18	34·8	111
Ketupa ceylonensis (Ceylonese Fishing-Owl).	4	10	26
K. javanensis (Javanese Fishing-Owl).	5	37	51
Scops, whole genus	17	8·6	45
S. asio (American Scops Owl)	1	26	26
S. giu (Scops Owl)	10	4·4	9
S. glabripes (Smooth-footed Scops Owl)	1	45	45
S. lempiji (Horsfield's ,,)	1	1	1
S. leucotis (White-eared ,,)	3	10	16
S. senegalensis (Senegal ,,)	1	2	2
Scotopelia peli (Pel's Owl)	1	5	5
Pulsatrix torquata (Downy Owl)	10	40	87
Sceloglaux albifacies (White-faced Owl)	1	33	33
Athene brama (Spotted Owl)	2	9·5	17
A. noctua (Naked-footed Owlet)	14	13·5	34
Ninox boobook (Boobook Owl)	3	26	50
N. novæ-seelandiæ (New Zealand Owl)	1	17	17
Speotyto cunicularia (Burrowing ,,)	46	21	65
Glaucidium passerinum (Passerine ,,)	13	6·5	17
G. phalænoides (Brown ,, ,,)	1	6	6
Nyctea scandiaca (Snowy Owl)	9	22	75
Surnia funerea (American Hawk Owl)	1	5	5

Summary of Striges.

We know from Mr. J. H. Gurney's paper (*loc. cit.* p. 36) that the potential longevity of Owls is far in excess of the maximum durations recorded here. On excellent authority, that writer cites an Eagle-Owl of 68 years, a *Ketupa* of 39 years, and a Tawny Owl of 26 years. The longest record on my list is that of an Indranee Owl which lived for over 11 years in the Gardens, and at the present time there are alive a Milky Eagle-Owl which has been for 19 years and a Pel's Owl which has been for 12 years in the Gardens. Until comparatively recently the quarters assigned to the Owls at the Gardens were extremely bad; it was assumed that Owls required neither light nor space. They have now been given better accommodation, and it is interesting to state, that except the Barn Owls, all the Owls take the fullest opportunity of sunning themselves and spend the greater part of their time fully exposed. Although a good deal must be discounted as a direct reaction to unfavourable conditions, it is still clear that the viability of Owls is not good; not only are the maximum durations far below what we know to be the potential longevities, but the average durations are in most cases extremely low. Owls, as is well known, have an unusually capacious hind-gut with very large cæca.

It is interesting to notice that all Capt. Flower's records of Owls are relatively low, just over 3 years being the highest.

PSITTACI.

NESTORIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Nestor notabilis (Mountain Ka-ka) ...	14	41	227
LORIIDÆ.			
Chalcopsittacus scintillatus (Red-fronted Lory).	1	34	34
Eos, whole genus..........................	13	46·7	220
E. riciniata (Violet-necked Lory)......	4	22·5	50
E. reticulata (Blue-streaked ,,)......	3	32	59
E. rubra (Red Lory)	5	83	220
E. wallacei (Wallace's Lory)	1	2	2
Lorius, whole genus	26	39·9	107
L. domicella (Purple-capped Lory)...	10	37·3	88
L. flavo-palliatus (Yellow-backed ,,)...	4	30	60
L. garrulus (Chattering ,,)...	4	59	107
L. lory (Three-coloured ,,)...	7	35·6	105
L. tibialis (Blue-thighed ,,)...	1	53	53
Trichoglossus, whole genus..............	31	55	210
T. cyanogrammus (Green-naped Lorikeet).	1	77	77
T. forsteni (Forsten's Lorikeet)......	1	14	14
T. hæmatodes (Blue-faced ,,)......	5	87	148
T. mitchelli (Mitchell's ,,)......	1	137	137
T. novæ-hollandiæ (Swainson's Lorikeet)	14	51·8	210
T. ornatus (Ornamental ,,)	7	38	84
T. rubritorques (Blue-bellied ,,)	2	20·5	22
Psitteuteles chlorolepidotus (Scaly-breasted Lorikeet).	6	24	59
Glossopsittacus concinnus (Musky Lorikeet).	11	20·7	60
CACATUIDÆ.			
Microglossus aterrimus (Great Black Cockatoo).	3	59·6	96
Calyptorhynchus banksi (Banksian Cockatoo).	3	221	310
C. funereus (Funereal Cockatoo)	2	44·5	87
Callocephalon galeatum (Ganga Cockatoo)	1	85	85
Cacatua, whole genus.....................	84	55	229
C. alba (Greater White-crested Cockatoo).	5	66	92
C. citrina (Citron-crested ,,)	3	142	183
C. ducorpsi (Ducorps's ,,)	3	36	67

CACATUIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Cacatua galerita (Greater Sulphur-crested Cockatoo).	8	49	113
C. goffini (Goffin's Cockatoo).	5	66·8	182
C. gymnopis (Bare-eyed ,,).	2	113·5	131
C. hæmaturopygia (Red-vented ,,).	3	56	107
C. leadbeateri (Leadbeater's ,,).	17	40	98
C. moluccensis (Rose-crested ,,).	10	49·5	229
C. ophthalmica (Blue-eyed ,,).	5	70	112
C. roseicapilla (Roseate ,,).	10	12·4	41
C. sanguinea (Blood-stained ,,).	1	204	204
C. sulphurea (Lesser Sulphur-crested Cockatoo).	8	46	117
C. triton (Triton Cockatoo) …………	4	118	209
Licmetis nasica (Slender-billed Cockatoo)	5	58	95
L. pastinator (Western ,, ,,)	4	100	153
Calopsittacus novæ-hollandiæ (Cockateel)	61	33	136
PSITTACIDÆ.			
Anodorhynchus, whole genus…………	8	111	276
A. glaucus (Glaucous Macaw) ………	1	107	107
A. hyacinthinus (Hyacinthine Macaw)	4	95	117
A. leari (Lear's Macaw) …………………	3	134	276
Cyanopsittacus spixi (Spix's Macaw) .	2	63·5	65
Ara, whole genus ……………………	49	57·5	199
A. ambigua (Ambiguous Macaw)…	2	147	199
A. ararauna (Blue-and-Yellow ,,)…	16	46	170
A. chloroptera (Red-and-Yellow ,,)…	9	66	191
A. hahni (Hahn's ,,)…	2	26	45
A. macao (Red-and-Blue ,,)…	9	60	177
A. maracana (Illiger's ,,)…	7	41	91
A. militaris (Military ,,)…	2	56	108
A. nobilis (Noble ,,)…	1	172	172
A. severa (Severe ,,)…	1	21	21
Conurus, whole genus ………………	90	56	248
C. acuticaudatus (Sharp-tailed Conure)	1	1	1
C. æruginosus (Brown-throated ,,)	24	40	144
C. aureus (Golden ,,)	8	76	153
C. auricapillus (Golden-headed ,,)	4	49	139
C. aztec (Aztec ,,)	2	18·5	21
C. cactorum (Cactus ,,)	2	32	54
C. canicularis (Petz's ,,)	4	32	44
C. guarouba (Golden ,,)	2	111·5	129
C. hæmorrhous (Blue-crowned ,,)	8	107	248
C. holochlorus (Mexican ,,)	1	92	92
C. jendayi (Yellow-headed ,,)	12	51	171
C. nanday (Black-headed ,,)	9	71·5	189
C. ocularis (Eyed ,,)	1	1	1
C. chloropterus (Green-winged ,,)	5	53	128

Psittacidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Conurus rubritorquis (Red-collared Conure)	1	19	19
C. rubrolarvatus (Red-masked ,,)	1	7	7
C. solstitialis (Yellow ,,)	4	42	74
C. wagleri (Wagler's ,,)	1	144	144
Conuropsis carolinensis (Carolina ,,)	6	81	114
Cyanolyseus patagonus (Smaller Patagonian Conure).	10	36·7	65
Henicognathus leptorhynchus (Slight-billed Parrakeet).	1	184	184
Microsittace ferruginea (Chilian Conure)	1	36	36
Pyrrhura, whole genus	21	54	172
P. cruentata (Red-eared Conure)	5	22	44
P. leucotis (White-eared ,,)	9	51	112
P. perlata (Pearly ,,)	2	98	172
P. vittata (Red-bellied ,,)	5	73	120
Myopsittacus monachus (Grey-breasted Parrakeet).	15	40	124
Bolborhynchus lineolatus (Lineolated Parakeet).	4	34	48
Psittacula passerina (Passerine Parrot)	17	22	57
Brotogerys, whole genus..................	30	35	93
B. chrysopterus (Golden-winged Parrakeet)	1	57	57
B. jugularis (Tovi ,,)	5	34	65
B. pyrrhopterus (Orange-flanked ,,)	4	52	78
B. tirica (All-green ,,)	8	32	93
B. tui (Tui ,,)	9	30	46
B. tuipara (Golden-fronted ,,)	1	45	45
B. virescens (Yellow-winged ,,)	2	19	20
Chrysotis, whole genus	168	43	312
C. æstiva (Blue-fronted Amazon)	11	36	103
C. agilis (Active ,,)	3	3	7
C. albifrons (White-browed ,,)	10	18	74
C. amazonica (Orange-winged ,,)	9	55	228
C. augusta (August ,,)	2	35·5	70
C. auripalliata (Golden-naped ,,)	8	83	312
C. autumnalis (Yellow-cheeked ,,)	8	34	122
C. bodini (Bodinus' ,,)	2	83	153
C. bouqueti (Bouquet's ,,)	1	72	72
C. brasiliensis (Red-tailed ,,)	3	66	128
C. dufresniana (Dufresne's ,,)	2	20	35
C. caymanensis (Cayman ,,)	1	11	11
C. collaria (Red-throated ,,)	6	36	62
C. farinosa (Mealy ,,)	6	52	68
C. festiva (Festive ,,)	4	35	49
C. finschi (Finsch's ,,)	3	63	121
C. guatemalæ (Guatemalan ,,)	2	14	28
C. guildingi (Guilding's ,,)	8	41	69

PSITTACIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Chrysotis leucocephala (White-fronted Amazon)	8	32	85
C. levaillanti (Levaillant's ,,)	8	68	157
C. mercenaria (Mercenary ,,)	1	13	13
C. ochrocephala (Yellow-fronted ,,)	8	45	88
C. ochroptera (Yellow-shouldered ,,)	6	50	136
C. panamanensis (Yellow-billed ,,)	6	60	147
C. prœtrii (Prêtre's ,,)	4	12	18
C. rhodocorytha (Red-topped ,,)	6	36·5	119
C. salvini (Salvin's ,,)	6	40	82
C. ventralis (Sallé's ,,)	4	42	95
C. versicolor (Blue-faced ,,)	2	25	37
C. vinacea (Vinaceous ,,)	3	34	60
C. viridigena (Green-cheeked ,,)	9	63·5	123
C. vittata (Red-fronted ,,)	3	48	95
C. xantholora (Yellow-lored ,,)	5	46	83
Pachyurus brachyurus (Short-tailed Parrot).	2	30·5	52
Pionus, whole genus	28	29	111
P. chalcopterus (Bronze-winged Parrot)	2	26	49
P. fuscus (Dusky ,,)	9	14·5	34
P. maximiliani (Maximilian's ,,)	3	69	111
P. menstruus (Red-vented ,,)	11	23·8	62
P. senilis (White-headed ,,)	1	11	11
P. sordidus (Sordid ,,)	2	73·5	76
Deroptyus accipitrinus (Hawk-headed Caique).	9	49	125
Pionopsittacus pileatus (Red-capped Parrot).	2	1	1
Caica, whole genus......................	16	47	248
C. leucogastra (White-bellied Caique).	2	6·5	8
C. melanocephala (Black-headed ,,).	12	39	104
C. xanthomera (Yellow-thighed ,,).	2	130	248
Pœocephalus, whole genus	46	32	249
P. fuscicapillus (Brown-headed Parrot)	2	53·5	55
P. fuscicollis (Brown-necked ,,)	4	79	241
P. gulielmi (Jardine's ,,)	6	12	49
P. meyeri (Meyer's ,,)	8	45	249
P. robustus (Levaillant's ,,)	2	24	45
P. rueppelli (Rüppell's ,,)	6	3·8	16
P. senegalus (Senegal ,,)	18	30	187
Psittacus erithacus (Grey ,,)	22	13	57
P. timneh (Timneh ,,)	4	84	123
Coracopsis, whole genus..................	13	164·7	648
C. barklyi (Praslin Parrot)...........	6	93	152
C. nigra (Lesser Vasa ,,)...........	4	98	144
C. vasa (Greater ,, ,,)...........	3	397	648
Eclectus, whole genus....................	35	31	119
E. cardinalis (Cardinal Eclectus)	1	38	38

PSITTACIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Eclectus pectoralis (Red-sided Eclectus)	13	34	90
E. roratus (Grand ,,)	12	47	119
E. westermani (Westerman's ,,)	9	4·6	15
Tanygnathus, whole genus …………	12	62	189
T. luzonensis (Blue-crowned Parrakeet)	3	19	37
T. megalorhynchus (Great-billed ,,)	1	154	154
T. muelleri (Mueller's ,,)	8	66	189
Palæornis, whole genus ………………	96	41	250
P. alexandri (Alexandrian Parrakeet).	15	·53	247
P. caniceps (Grey-headed ,,).	1	2	2
P. cyanocephala (Blossom-headed ,,).	11	56	97
P. docilis (Rose-ringed ,,).	8	43	157
P. fasciata (Banded ,,).	10	69·6	160
P. longicauda (Malaccan ,,).	7	12	26
P. nicobarica (Red-cheeked ,,).	1	3	3
P. peristerodes (Malabar ,,).	7	47	86
P. rosa (Rosy ,,).	6	15	30
P. torquatus (Ring-necked ,,).	30	34	250
Polytelis, whole genus ………………	15	31	72
P. alexandræ (Princess of Wales' Parrakeet)	3	23	49
P. barrabaudi (Barrabaud's ,,)	4	53	72
P. melanurus (Black-tailed ,,)	8	23	40
Ptistes erythropterus (Red-winged Parrakeet).	13	33	61
Aprosmictus coccinopterus (Smaller Red-winged Parrakeet).	1	162	162
A. cyanopygius (King ,,).	19	27·5	80
Pyrrhulopsis, whole genus…………	17	44	116
P. personata (Masked Parrakeet) ……	7	52	89
P. splendens (Shining ,,) ……	5	44	116
P. tabuensis (Tabuan ,,) ……	5	31	113
Psittinus incertus (Blue-rumped Parrakeet).	1	20	20
Agapornis, whole genus ………………	68	23	97
A. cana (Grey-headed Love-bird) …	17	30	97
A. pullaria (West-African ,,) …	38	16	56
A. roseicollis (Rosy-faced ,,) …	13	22	40
Loriculus, whole genus ………………	40	17	80
L. chrysonotus (Golden-backed Hanging-Parrakeet).	3	26	31
L. galgulus (Blue-crowned Hanging-Parrakeet).	21	17	80
L. indicus (Ceylonese Hanging-Parrakeet).	15	15	37
L. pusillus (Javan Hanging-Parrakeet)	1	9	9
Platycercus, whole genus ……………	83	42·6	202
P. adelaidæ (Adelaide Broad-tail)……	2	31	52

PSITTACIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Platycercus barnardi (Barnard's Broad-tail)	5	86	202
P. browni (Brown's Broad-tail) ...	1	23	23
P. elegans (Pennant's ,, ,,) ...	17	29	143
P. erythropeplus (Red-mantled Broad-tail).	1	22	22
P. eximius (Rose-hill Broad-tail)	22	32·5	130
P. flaveolus (Yellow-rumped Broad-tail)	4	58·7	153
P. flaviventris (Yellow-bellied ,, ,,)	2	32·5	38
P. icterotis (Stanley Broad-tail).........	4	40	136
P. pallidiceps (Pale-headed Broad-tail)	9	40	128
P. pileatus (Pileated ,, ,,)	4	41	59
P. semitorquatus (Yellow-collared Broad-tail).	2	103	103
P. zonarius (Bower's ,, ,,)	10	55	133
Psephotus, whole genus	33	22·3	113
P. chrysopterygius (Golden-winged Parrakeet).	1	8	8
P. hæmatonotus (Blood-rumped Parrakeet).	15	23	67
P. multicolor (Many-coloured ,,).	7	20	113
P. pulcherrimus (Beautiful ,,).	10	16	57
Neophema, whole genus	53	22	75
N. bourkii (Bourke's Grass-Parrakeet)	6	36	62
N. chrysogastra (Orange-bellied Grass-Parrakeet).	4	23	55
N. elegans (Elegant Grass-Parrakeet)	12	21·5	68
N. pulchella (Turquoisine Grass-Parrakeet).	28	20	75
N. splendida (Splendid Grass-Parrakeet)	2	12	18
N. venusta (Blue-banded Grass-Parrakeet).	1	11	11
Cyanorhamphus, whole genus	31	17	62
C. auriceps (Golden-headed Parrakeet)	5	19	54
C. malherbi (Alpine ,,)	4	14	32
C. novæ-zealandiæ (New Zealand Parrakeet).	16	15	43
C. saisseti (Saisset's ,,).	2	21	39
C. unicolor (Antipodes Island ,,).	4	26	62
Nymphicus cornutus (Horned ,,).	2	62·5	84
N. uvæensis (Uvæan ,,).	9	12·5	71
Nanodes discolor (Swift ,,).	8	23	43
Melopsittacus undulatus (Undulated Grass-Parrakeet).	109	23·6	111
Geopsittacus occidentalis (Western Ground-Parrakeet).	1	4	4
STRINGOPIDÆ.			
Stringops habroptilus (Night Parrot) .	4	8·2	16

Summary of Psittaci.

Popular repute and exact records agree in assigning a high potential longevity to Parrots. Metchnikoff (*op. cit.* p. 52) cites on the authority of Levaillant a Grey Parrot of 93 years, on that of Butler, a Sulphur-crested Cockatoo of 81 years, on that of Abrahams, an Amazon of 102 years, whilst he himself owned an Amazon which died at an age between 70 to 75 years. The figures in Mr. J. H. Gurney's list (*op. cit.* p. 36) are lower, the highest being a Blue Macaw of 64 years. The figures of maximum duration at the Gardens are very much lower in most cases. A Greater Vasa Parrot (already cited by Gurney) lived for 54 years. With regard to the others the figures of maximum duration are distributed nearly equally throughout the different groups of Psittaci; thus an Amazon and a Banksian Cockatoo reached about 26 years, a Macaw 23 years, a Conure, a Pœocephalus Parrot and a small Parrakeet 20 years, a *Nestor* 19 years, a Lory 18 years, and a Lorikeet 17 years, whilst there are at present alive a Lesser Vasa Parrot which has lived in the Gardens for 26 years, and a Lorikeet of 17 years' duration.

I have no information as to the ages of the Parrots on their arrival at the Gardens, but as in an assemblage of 1480 birds, selected at random so far as age is concerned, there must have been many young birds, the maximum ages attained would appear to show that Parrots have not a high viability under the conditions to which they have been subjected, as otherwise there would have been a more frequent and closer approach of maximum duration to potential longevity. The records of average duration are not more favourable. The great majority of the birds had an average duration of somewhere between 2 and 4 years, a few such as the Lorikeets, Cockatoos, Conures, and Caiques were in most cases between 4 and 6 years, whilst the Macaws usually showed averages of over 6 years. I can see only the vaguest possible correlation between average and maximum durations and size, but on the whole there are more of the larger birds amongst the higher figures.

As we know that Psittaci have a high potential longevity, it is clear that either the conditions under which they are kept in captivity are markedly unfavourable, or that these birds have a low viability. In the period in question, the examples of this group were kept in a rather crowded house, well warmed in cold weather. A certain number of them were placed out of doors (chiefly Macaws and Cockatoos) in good weather, but were chained to perches. The vast majority of them were in relatively small cages, and never had access to open air, whilst none had the opportunity of flying. It is of course clear that exceptional individuals can do well without exercise, and it is highly probable that at least most of the birds cited as instances of high longevity, were kept in cages or on stands. But it is equally clear that such conditions, and in particular the absence of fresh air, are not favourable.

Parrots are typically vegetarian birds, although, as is well known, most of them do well if some animal material is added to their diet. The intestinal tract is long and unusually complex, but it is narrow in calibre, there are no cæca, and the greater portion appears to correspond with the small intestines, whilst there is little that is used as a reservoir for waste material, or that can be a probable seat of putrefaction. I cannot see that the indications point towards their low viability being the result of their constitution, and am disposed to attribute the relatively low maximum and average durations to unsatisfactory conditions. The Zoological Society has made experiments in recent years, in giving the larger parrots free exposure to the open air, without artificial heat. The experiment has not been of sufficiently long duration to test the effect on longevity; but even though the conditions are not specially favourable in the particular aviary, the general result appears to be good. I have no doubt that the ideal management is a combination of open-air flight cages with sheltered, and quite possibly warmed retreats.

Capt. Flower's best records are a Bare-eyed and a Slender-billed Cockatoo, still alive after 12 years' duration. As it was only in 1898 that he took charge of the Giza Gardens and began to make his records, about 12 years' duration was the maximum possible.

ACCIPITRES.

FALCONIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pandion haliaëtus (Osprey)	15	16	84
Circus, whole genus	23	15	43
C. æruginosus (Marsh Harrier)	5	19	42
C. cineraceus (Montagu's ,,)	9	9	23
C. cyaneus (Hen ,,)	1	10	10
C. gouldi (Gould's ,,)	1	14	14
C. macrurus (Swainson's ,,)	1	43	43
C. maurus (Moor ,,)	6	16	39
Buteo, whole genus	95	25	225
B. albicaudatus (White-tailed Buzzard)	4	47	116
B. auguralis (Augura ,,)	2	8·5	13
B. borealis (Red-tailed ,,)	11	24	93
B. desertorum (African ,,)	10	37·6	225
B. erythronotus (Red-backed ,,)	8	18·5	38
B. ferox (Long-legged ,,)	4	16	20
B. jackal (Jackal ,,)	11	34	81
B. pennsylvanicus (Pennsylvanian ,,)	2	37·5	41
B. poliosomus (Patagonian ,,)	1	25	25
B. vulgaris (Common ,,)	42	19·5	72
Archibuteo lagopus (Rough-legged Buzzard).	22	14·5	36
Pernis apivorus (Honey Buzzard)	4	57	122
P. ptilorhyncha (Crested Honey Buzzard)	1	22	22

FALCONIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Haliastur indus (Brahminy Kite)	1	62·5	110
H. intermedius (Javan Brahminy Kite)	2	116	116
Asturina, whole genus	6	8	23
A. magnirostris (Great-billed Buzzard Hawk).	1	11	11
A. nattereri (Natterer's Hawk)	3	10	23
A. nitida (Shining Buzzard Hawk)	2	2·5	4
Urubitinga, whole genus	5	30	49
U. anthracina (Ash-coloured Urubitinga).	1	49	49
U. meridionalis (Rusty Urubitinga)	3	33	37
U. zonura (Banded-tailed Urubitinga)	1	2	2
Buteogallus nigricollis (Black-necked Buzzard).	1	8	8
Leucopternis palliatus (Mantled Buzzard).	2	9·5	14
Geranoaëtus melanoleucus (Chilian Sea-Eagle).	16	68·5	333
Harpyhaliaëtus coronatus (Crowned Harpy).	1	129	129
Morphnus guianensis (Guianan Crested Eagle).	2	20	23
Thrasaëtus harpyia (Harpy Eagle)	7	18	48
Helotarsus ecaudatus (Bateleur ,,)	15	54	145
Haliaëtus, whole genus	60	35·5	122
H. albicillus (White-tailed Eagle)	22	34	86
H. leucocephalus (White-headed Sea-Eagle).	15	36	122
H. leucogaster (White-bellied Sea-Eagle).	9	36	91
H. leucoryphus (Mace's Sea-Eagle)	1	1	1
H. vocifer (Vociferous ,, ,,)	13	39	86
Polioaëtus plumbeus (Plumbeous Fish-Eagle.)	2	74	82
Aquila, whole genus	83	66·3	257
A. adalberti (Prince Adalbert's Eagle).	2	90	136
A. audax (Wedge-tailed ,,).	15	94·5	257
A. chrysaëtus (Golden ,,).	39	35	170
A. clanga (Spotted ,,).	2	38·5	65
A. imperialis (Imperial ,,).	8	78	141
A. nævioides (Tawny ,,).	12	56·5	150
A. verreauxi (Vulturine ,,).	5	31	77
Nisaëtus, whole genus	13	36·6	152
N. fasciatus (Bonelli's Eagle)	8	28	66
N. pennatus (Booted ,,)	4	51	152
N. spilogaster (African Hawk-Eagle)	1	46	46
Spizaëtus, whole genus	23	32·8	77
S. bellicosus (Martial Hawk-Eagle)	2	46	69

Falconidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Spizaëtus caligatus (Malayan Hawk-Eagle).	1	22	22
S. ceylonensis (Ceylonese ,, ,,)...	3	21	46
S. coronatus (Crowned ,, ,,)...	10	38·7	77
S. nipalensis (Spotted ,, ,,)...	3	29	45
S. orientalis (Japanese ,, ,,)...	1	21	21
S. ornatus (Ornamented ,, ,,)...	2	32	43
S. tyrannus (Tyrant ,, ,,)...	1	15	15
Lophaëtus occipitalis (Black-crested Eagle).	5	34	49
Circaëtus gallicus (Short-toed Eagle) .	13	15	40
Dryotriorchis spectabilis (Beautiful Wood-Hawk).	1	14	14
Spilornis, whole genus	4	18·5	45
S. bacha (Bacha Eagle)	2	8·5	9
S. cheela (Cheela ,,)	1	12	12
S. spilogaster (Ceylonese Serpent-eater)	1	45	45
Accipiter, whole genus	11	1·6	4
A. nisus (Sparrow Hawk)	9	1·7	4
A. pileatus (Pileated ,,)	1	1	1
A. melanoleucus (Black and White Hawk).	1	1	1
Melierax, whole genus	12	16·5	91
M. monogrammicus (One-streaked Hawk).	7	10	31
M. musicus (Chanting Hawk)	1	91	91
M. polyzonus (Many-zoned ,,)	4	8·7	21
Astur, whole genus	35	16·3	150
A. approximans (Allied Goshawk)...	4	58	150
A. novæ-hollandiæ (White ,,)...	4	38	75
A. palumbarius (Common ,,)...	22	7	22
A. tachiro (Tachiro ,,)...	4	6·5	9
A. tibialis (Gambian ,,)...	1	1	1
Falco, whole genus	108	18·5	117
F. æsalon (Merlin)	7	17·5	94
F. biarmicus (Bearded Falcon)	1	40	40
F. concolor (Ash-coloured ,,)	2	25	43
F. eleonoræ (Eleonora ,,)	1	4	4
F. feldeggi (Feldegg's ,,)	1	28	28
F. fusco-cærulescens (Orange-thighed Falcon).	2	34	42
F. lanarius (Lanner Falcon)	14	35	117
F. melanogenys (Black-cheeked Falcon)	3	21	43
F. peregrinus (Peregrine Falcon)	61	15	89
F. punicus (Mediterranean Peregrine Falcon).	1	2	2
F. sacer (Saker Falcon)	3	23	39
F. subbuteo (Hobby)	12	9	40
Hierofalco candicans (Greenland Falcon)	2	32·5	51

FALCONIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Hierofalco islandus (Iceland Falcon)...	6	33	93
Hieracidea berigora (Berigora Hawk) .	5	32	101
Tinnunculus, whole genus	81	15·8	151
T. alaudarius (Common Kestrel)......	45	17	76
T. cenchris (Lesser ,,)......	9	17	76
T. cenchroides (Nankeen ,,)......	2	7·5	13
T. dominicensis (Dominican ,,)......	13	13	63
T. gracilis (Slender ,,)......	2	12	15
T. moluccensis (Molucca ,,)......	1	10	10
T. rupicolus (S. African ,,)......	2	9	11
T. sparverius (American ,,)......	4	10·5	14
T. vespertinus (Red-footed ,,)......	3	71	151
Hypotriorchis chicquera (Red-headed Merlin).	1	5	5
Milvus, whole genus	30	68·5	191
M. govinda (Indian Kite)...........	4	55	89
M. migrans (Black ,,)...........	8	58	191
M. ægyptius (Egyptian ,,)...........	12	65	165
M. ictinus (Common ,,)...........	6	98	173
Baza lophotes (Crested Black Kite) ...	1	1	1
Elanus cæruleus (Black-shouldered Kite).	6	8	17
Rostrhamus sociabilis (Sociable Marsh-Hawk).	2	4	7
Herpetotheres cachinnans (Laughing Falcon).	2	10·5	12
Milvago, whole genus	26	65	168
M. australis (Forster's Milvago) ...	5	21	48
M. chimachima (Chimachima ,,) ...	5	74	129
M. chimango (Brown ,,) ...	14	69	164
M. megalopterus (Long-winged ,,) ...	2	113	168
Polyborus brasiliensis (Brazilian Caracara).	7	143	496
Polyboroides typicus (Banded Gymnogere)	2	39	45
VULTURIDÆ.			
Vultur, whole genus	19	94	284
V. auricularis (Sociable Vulture)	7	93	284
V. calvus (Pondicherry ,,)	3	69	68
V. monachus (Cinereous ,,)	8	115·5	183
V. occipitalis (Occipital ,,)	1	2	2
Gyps, whole genus	14	72	261
G. bengalensis (Bengal Vulture)	3	15	33
G. fulvus (Griffon ,,)	8	85·5	261
G. kolbii (Kolbe's ,,)	1	44	44
G. rueppelli (Rüppell's ,,)	2	116	168
Neophron percnopterus (Egyptian Vulture).	9	27	99

VULTURIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Gypohierax angolensis (Angolan Vulture).	12	40	66
Gypaëtus barbatus (European Bearded Vulture).	6	113	284
SERPENTARIIDÆ.			
Serpentarius reptilivorus (Secretary Vulture).	26	12	59
CATHARTIDÆ.			
Cathartes, whole genus	23	22	70
C. atratus (Black Vulture)	15	18	57
C. aura (Turkey ,,)	7	30	70
C. urubitinga (Yellow-headed Vulture) .	1	8	8
Sarcorhamphus æquatorialis (Brown Condor).	1	96	96
S. gryphus (Condor)	6	155	403
Gypagus papa (King Vulture)	18	20	87

Summary of Accipitres.

The potential longevity of Accipitrine birds is well known to be great, although, as in most other cases, well-authenticated records are considerably lower than the ages assigned by popular rumour. Metchnikoff (*op. cit.* p. 53) refers to a White-headed or Egyptian Vulture of 118 years, and a Golden Eagle of 104. Mr. J. H. Gurney's exact records (*loc. cit.* p. 37) range downwards from a Bateleur Eagle of 55 years and a Condor of 52. The maximum durations in my record are considerably lower; those over 20 years are a Caracara of over 41, a Condor of nearly 34, a Chilian Sea-Eagle of nearly 28, a Sociable and an Angolan Vulture which reached nearly 24, a Griffon of nearly 22 and a Wedge-tailed Eagle of more than 21 years; whilst there is at present alive, a Milvago that has been over 24 years in the Gardens. The average durations mostly under 2 years are of Ospreys, Harriers, Hawks, Falcons, Kestrels, Secretary Bird, and the American Vultures; those mostly between 2 and 4 years, are of Buzzards, Sea-Eagles, and the larger Hawk-Eagles; those mostly between 4 and 6 years are of the Chilian Sea-Eagles, Goshawks, and Kites; whilst the records above 6 years belong chiefly to Wedge-tailed Eagles, Imperial Eagles, the larger Vultures and the Condor. There is a rough relation between size and viability, and there is the usual very low viability of the common European forms. The conditions under which the birds of prey have been kept, in the period covered, cannot be said to have led to a favourable result. In the great majority of cases no artificial heat was provided, even in winter, and there was full access to open air, but especially in the case of the smaller birds, the quarters were small and dark, and there was no provision for exercise. If the records be compared with those of the Striges, it will be seen, however, that both average and maximum durations are considerably better in the case of the diurnal birds of prey. No intelligent anatomist can now doubt that the two groups are far separate amongst birds, and one of the notable differences is in the structure of the alimentary tract. In all the Accipitrine birds, although the intestines are relatively long and arranged in a complex pattern, the hind-gut and cæca are extremely reduced, and the portion of the gut in which there is the greatest opportunity for intestinal putrefaction therefore has a relatively very small capacity.

Capt. Flower records only two Accipitrine birds—a Griffon Vulture and an Egyptian Vulture—that are still alive after 12 years' duration, the maximum possible in his records.

STEGANOPODES.

PELECANIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pelecanus, whole genus	21	139	380
P. conspicillatus (Australian Pelican) .	2	285	380
P. crispus (Crested „) .	2	274·5	329
P. fuscus (Brown „) .	3	65	121
P. manillensis (Spot-billed „) .	2	54	65
P. mitratus (Mitred „) .	3	130	261
P. onocrotalus (White „) .	3	239	350
P. rufescens (Red-backed „) .	6	66	152

Mr. J. H. Gurney (*loc. cit.* p. 38) gives the records of six Pelicans ranging from 41 to 18 years, and the maximum durations given above, ranging downwards from nearly 32 years, are all remarkably high, whilst the average durations show that these birds are probably the most highly viable of all the birds and mammals usually kept in captivity. They were not provided with artificial heat, but throughout the day were exposed fully to the weather, whilst at night, and occasionally in very cold or foggy conditions, they were shut up in a small wooden shelter. As compared with other fish-eating birds, the alimentary tract is relatively short and simple, and the cæca and hind-gut are small (although not so reduced as in Accipitrine birds) and uncapacious.

Capt. Flower records one White Pelican still alive after 12 years.

FREGATIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Fregata aquila (Great Frigate-bird) ...	5	45·6	91

It is most probable that only weak or injured examples of this oceanic bird usually find their way into captivity, and the records, I think, must be interpreted as showing a high viability. The intestinal tract is simpler than that of Pelicans, with the hind-gut and cæca more reduced. These birds have been kept in an aviary with warmed interior and open-air front cages.

PHALACROCORACIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sula, whole genus	39	8·3	40
S. bassana (Gannet)	27	6	19
S. leucogastra (Brown Gannet)	5	15	40
S. piscator (White ,,)	2	14	19
S. serrator (Australian ,,)	5	8·8	16
Phalacrocorax, whole genus	84	12	94
P. brasilianus (Brazilian Cormorant)	9	10·5	55
P. africanus (African ,,)	2	23·5	36
P. carbo (Common ,,)	53	10·5	52
P. carunculatus (Rough-faced ,,)	2	28	49
P. graculus (Shag)	15	10	44
P. javanicus (Javan Cormorant)	1	38	38
P. lugubris (Mournful ,,)	1	94	94
P. varius (Pied ,,)	1	1	1

Mr. J. H. Gurney (*loc. cit.* p. 38) quotes from H. O. Forbes the record of a Common Cormorant which lived for 23 years. The maximum durations on my list, ranging from nearly 8 years downwards, are very much lower, whilst the average durations of both Gannets and Cormorants seldom exceed one year. There is the usual remarkable failure with local species—a failure which would appear much greater if a considerable number of entries of birds that lived less than a month had not been excluded from the records. The intestinal tracts are of the fish-eating type—relatively large and of small calibre, but the hind-gut and cæca are very rudimentary, and there seems little opportunity for intestinal putrefaction.

PLOTIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Plotus, whole genus	16	22	103
Plotus anhinga (American Darter)	12	18	53
P. levaillanti (Levaillant's ,,)	2	18	34
P. melanogaster (Indian ,,)	2	55·5	103

J. H. Gurney (*loc. cit.* p. 38) gives an instance of an American Darter of 12 years old; I do not know of any other records. The intestinal tract is similar to that of other Steganopodes, but although the cæca (or single cæcum) are vestigial, the hind-gut is relatively more capacious and larger. These birds were kept in a house (the Fish House) that was warmed in winter, and their average duration and maximum duration show no high viability.

Summary of Steganopodes.

Pelecans, Frigate-birds, Gannets, Cormorants and Darters, whether or no they form a coherent zoological group, differ very little in their requirements in captivity, and receive very much the same treatment. They appear to me to be a group of potentially great longevity and viability, these, moreover, being fairly in proportion to size. The records of Phalacrocoracidæ are much lowered by the number of European birds, which like most European animals have a very heavy death-rate in captivity.

HERODIONES.

ARDEIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Ardea, whole genus	90	25	110
A. agami (Agami Heron) ...	1	5	5
A. alba (Great White ,,) ...	4	7·5	26
A. atricollis (Black-necked ,,) ...	1	24	24
A. bubulcus (Buff-backed ,,) ...	4	50	64
A. candidissima (Snowy ,,) ...	10	20	74
A. cinerea (Common ,,) ...	23	28	115
A. cocoi (Cocoi ,,) ...	4	42	93
A. egretta (Great American Egret) ...	16	31	100
A. garzetta (Little ,,) ...	4	35	98
A. goliath (Goliath Heron)..............	1	35	35
A. gularis (Slaty ,,)..............	7	19	72
A. herodias (Great American Heron).	1	31	31
A. novæ-hollandiæ (White-faced ,,).	2	13	17
A. purpurea (Purple ,,).	9	4·6	10
A. ralloides (Squacco ,,).	2	6·5	11
A. sumatrana (Typhon ,,).	1	69	69
Butorides, whole genus	9	14	53
B. atricapillus (Blue-capped Bittern) .	2	44·5	53
B. cyanurus (South American Little Bittern).	1	12	12
B. virescens (Green Bittern)	6	4	13
Ardetta involucris (Variegated Bittern).	3	23	40
A. minuta (Little Bittern)..............	8	6	19
Nycticorax, whole genus..................	64	30	199
N. caledonicus (Nankeen Night Heron).	2	99	107
N. gardeni (Garden's Night Heron).	6	9	32
N. griseus (Common ,, ,,).	31	37	199
N. violaceus (Violaceous ,, ,,).	25	19·5	61
Cancroma cochlearia (Boat-bill).........	9	21	53
Botaurus lentiginosus (American Bittern).	1	8	8
B. stellaris (Bittern)	3	23	54
Tigriosoma brasiliense (Tiger Bittern).	6	48·5	162
T. leucolophum (White-crested ,, ,,).	7	20·5	33

J. H. Gurney (*loc. cit.* p. 38) gives somewhat doubtful records of 60 and 30 years, and a well authenticated record of 22 years for a Common Heron. A duration of over 16 years for a Night Heron is the best on my list. The average and maximum durations show a rough correspondence with size; but the relations of average to maximum duration show rather a low viability for these birds. The intestinal tract is of the fish-eating type, relatively very large and of small calibre, but with vestigial cæca and with a reduced hind-gut. The conditions under which these birds have been kept differ; some were placed in open enclosures, others, especially in winter, in an aviary with warmed interior.

CICONIIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Ciconia, whole genus	56	25	111
C. alba (White Stork)	34	26	74
C. boyciana (Boyce's „)	2	14·5	28
C. nigra (Black „)	20	20	111
Dissura episcopus (White-necked Stork).	12	30	64
D. maguari (Maguari Stork)	10	40	84
Abdimia sphenorhyncha (White-bellied Stork).	3	50	81
Xenorhynchus australis (Black-necked Stork).	11	18	68
X. senegalensis (Saddle-billed „).	4	26	59
Mycteria americana (American Jabiru).	8	34·5	65
Leptoptilus, whole genus	19	46·5	227
L. argala (Indian Adjutant)	5	77	227
L. crumeniferus (Marabou Stork) ...	9	47	117
L. javanicus (Javan Adjutant)	5	15	35
Scopus umbretta (Tufted Umbre) ...	5	24	43
Tantalus loculator (American Tantalus).	7	10·5	23
Pseudotantalus ibis (African „).	13	15	31
P. leucocephalus (Indian „).	7	11·5	23

Mr. J. H. Gurney (*loc. cit.* p. 38) cites well authenticated records of a Black Stork of 30 years and a Jabiru of 36 years. Nearly 19 years for an Adjutant is the highest on this list, whilst the average durations vary, roughly in proportion to size, from about 4 years to about 1 year. During part of the period in consideration, the larger tropical Storks were kept in the Antelope House, which was warmed in winter; towards the end of the period a new house was erected, in which there were heated compartments leading to open-air paddocks to which the birds were admitted at the discretion of the keepers—a discretion usually exercised with a strong bias in favour of heat as opposed to air. The intestinal tract is relatively long and of small calibre but the hind-gut and cæca are very reduced. There appears to be no good reason in the structure of these birds for the relatively low viability which appears in the records.

PLATALEIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Platalea alba (African Spoonbill)	2	21	29
P. leucorodia (Spoonbill)	19	16·5	115
Ajaja rosea (Roseate Spoonbill).........	11	19	38
Ibis, whole genus	17	80	220
I. æthiopicus (Sacred Ibis)...............	8	94	191
I. bernieri (Bernier's „)...............	2	25	38
I. melanocephalus (Black-headed Ibis).	1	83	83
I. strictipennis (Australian Sacred „).	6	87	220
Carphibis spinicollis (Straw-necked Ibis).	4	109·8	300
Nipponia temmincki (Nippon „).	1	5	5
Theristicus caudatus (Black-faced „).	3	16	41
T. melanopis (Grey „).	5	18	31
Plegadis falcinellus (Glossy „).	18	30·5	112
P. guarauna (White-faced „).	2	5	5
Eudocimus, whole genus...................	43	25·5	143
E. albus (White Ibis)	5	69·5	143
E. longirostris (Red-billed „)	2	8·5	12
E. ruber (Scarlet „)	36	20	90

Mr. J. H. Gurney (*loc. cit.* p. 38) records from our own Gardens a Sacred Ibis alive at 20 years old, and another bird of the same species from Rotterdam of 11 years. In the list given above there is a Straw-necked Ibis with a duration of 25 years, and an Australian Sacred Ibis of over 18 years, whilst there are a number of other high records. The figures of average duration are very varied, but in several cases they extend to a number of years, the low figures being chiefly birds of which there were very few examples.

In the period in question nearly all these birds had free access to the open air, but in some cases had shelter in a heated aviary in winter. Ibises have a simply disposed but rather long intestinal tract, with the cæca and the hind-gut much reduced. It must be inferred from the figures that they are birds of good viability in proportion to their size.

Summary of Herodiones.

Herons, Storks, Spoonbills and Ibises form a coherent zoological group all chiefly carnivorous or piscivorous, with relatively long, narrow, intestinal tracts, the posterior region of which is reduced and uncapacious. Within the different groups there is a fair correspondence between duration and size, but this does not reach to the whole assemblage, as the Spoonbills and Ibises show a better viability than the Storks, whilst the Herons are lowest of all. I see no reason for assuming much difference (except perhaps in proportion to size) between the potential longevities of the three divisions, and must assume that the conditions of captivity have pressed most heavily on the Herons. I have not sufficient information to point to any special unfavourable circumstance in the case of the Herons.

Capt. Flower records no example of the Herodiones still alive after 12 years.

ODONTOGLOSSÆ.

PHŒNICOPTERIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Phœnicopterus, whole genus	23	82	273
P. ignipalliatus (South American Flamingo).	5	42	105
P. roseus (European Flamingo)	9	163	273
P. rubra (Ruddy „)	9	21	147

I can find no published statements regarding the longevity of these large birds, and the maximum duration of nearly 23 years for a European Flamingo is therefore specially interesting. I know of no reason for the greater success of the European form. The distribution of individual durations with regard to the maximum durations shows that the deaths with low duration have nearly always taken place soon after arrival: if the birds of any of the three species survived two or three months, they lived years. These birds live on a mixed diet, in captivity taking a good deal of grain; the alimentary tract is relatively long and slender, but the posterior portion and the cæca are more capacious than in most birds. They have been kept with complete exposure to the open air in summer, whilst in winter, in the period to which the records refer, they were usually transferred to an aviary with open-air cages and heated retreats. Flamingoes have a high longevity and viability under such conditions.

PALAMEDEÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Chauna cristata (Crested Screamer) ...	11	45·8	115
C. derbiana (Derbian „) ...	8	16·5	84
Palamedea cornuta (Horned „) ...	3	31·1	43

I am unaware of published records as to the longevity of Screamers. The maximum duration, over 9 years in the case of a Crested Screamer, is surpassed by two examples of the species, at present alive in the Gardens, after a duration of nearly 13 years As in the case of the Flamingoes, the incidence of the mortality was especially heavy on new arrivals: if the birds lived a few months, they usually approached the maximum duration recorded. Screamers are large, bulky birds, with the alimentary tract of a primitive type, the hind-gut and cæca being relatively capacious. They have been kept under conditions relatively similar to those of the Flamingoes, and certainly in proportion to their size cannot be regarded as highly viable.

ANSERES.

CYGNINÆ.	No. of Indiv.	Aver. dur. in months.	Max dur. in months.
Cygnus, whole genus	88	33·5	177
C. atratus (Black Swan) ...	13	18	72
C. buccinator (Trumpeter ,,) ...	7	55	144
C. bewicki (Bewick's ,,) ...	7	53	114
C. musicus (Whooper ,,) ...	8	55·5	132
C. olor (Mute ,,) ...	12	41·5	177
C. nigricollis (Black-necked ,,) ...	41	24	141
Coscoroba candida (Coscoroba ,,) ...	7	36	103

Mr. J. H. Gurney has recorded (*loc. cit.* p. 39), on the authority of W. J. Broderip, a Mute Swan of 70 years; the highest figure on my list is not quite 15 years. The distribution of the individual durations about the average, shows that the heaviest mortality was in those examples which lived only a few months, and were either new arrivals, or cygnets; if individuals survived the early period of detention, they approached the maximum.

ANSERANATINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Anseranas semipalmata (Black and White Goose).	6	171·5	229
PLECTROPTERINÆ.			
Plectropterus, whole genus...............	15	72	152
P. gambensis (Spur-winged Goose) ...	12	82	152
P. niger (Black ,, ,, ,,) ...	2	28·5	31
P. rueppelli (Rüppell's ,, ,,) ...	1	36	36
Cairina moschata (Muscovy Duck) ...	23	9	93
Sarcidiornis carunculata (American Black-backed Goose).	5	33	117
S. melanonota (Black-backed Goose)...	8	61	110
Rhodonessa caryophyllacea (Pin-headed Duck)	5	16	23
Aex galericulata (Mandarin ,,)	80	42	135
Aex sponsa (Summer ,,)	85	34	117
CEREOPSINÆ.			
Cereopsis novæ-hollandiæ (Cereopsis Goose).	13	36	19
ANSERINÆ.			
Chen, whole genus	10	112·7	198
C. hyperboreus (Wavy Snow-Goose)...	3	85	92
C. cærulescens (Blue ,, ,,)...	3	57	103
C. nivalis (Lesser ,, ,,)...	4	175	198
Anser, whole genus	41	71	289
A. albifrons (White-fronted Goose) ...	6	74	168
A. brachyrhynchus (Pink-footed Goose)	4	52	99
A. cinereus (Grey-Lag Goose)......	12	41·5	126
A. cygnoides (Chinese ,,)......	7	70	153

ANSERINÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Anser erythropus (Little Goose)......	2	174	289
A. indicus (Bar-headed ,,)......	8	124	261
A. segetum (Bean ,,)......	2	26·5	49
Bernicla, whole genus	61	36·3	142
B. brenta (Brent Goose)......	32	17	66
B. canadensis (Canada ,,)......	14	44	111
B. hutchinsi (Hutchins' ,,)......	2	86	119
B. leucopsis (Bernicle ,,)......	12	61	131
B. ruficollis (Red-breasted ,,)......	1	142	142
Nesochen sandvicensis (Sandwich Island Goose)	9	50	95
Chloephaga, whole genus	120	32	169
C. magellanica (Upland Goose)	83	25	111
C. melanoptera (Andean ,,)	7	17	39
C. poliocephala (Ashy-headed ,,)	8	54·5	169
C. rubidiceps (Ruddy-headed ,,)	22	56	162
Chenonetta jubata (Maned ,,)	21	62	187

Geese are popularly reputed to have a very high potential longevity; Mr. J. H. Gurney (*loc. cit.* p. 39) mentions, on the somewhat doubtful authority of Willughby, a domestic Goose, 80 years old, and on more exact authority a *Cereopsis* of 33 years and a Bernicle Goose of 32 years. The highest figure on my list is 24 years for a Little Goose; but the maximum and average durations (the latter in many cases are lowered by the inclusions of broods of goslings) show that these birds have a high viability.

ANATINÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Dendrocygna, whole genus...............	99	30	242
D. arborea (Black-billed Tree-duck)...	6	11	53
D. arcuata (Wandering ,, ,,)...	14	22·5	66
D. autumnalis (Red-billed ,, ,,)...	32	42	242
D. eytoni (Eyton's ,, ,,)...	2	27·5	29
D. fulva (Fulvous ,, ,,)...	5	44	76
D. javanica (Indian ,, ,,)...	8	18	48
D. major (Larger ,, ,,)...	11	24	57
D. viduata (White-faced ,, ,,)...	21	26	57
Chenalopex ægyptiaca (Egyptian Goose)	16	34	128
C. jubatus (Orinoco Goose)	14	27	82
Tadorna, whole genus	109	40	214
T. casarca (Ruddy Sheldrake)	22	42	214
T. cornuta (Common ,,)......	31	23	111
T. tadornoides (Australian ,,)......	15	52	186
T. variegata (Variegated ,,)......	41	47	172
Anas, whole genus	117	36·5	319
A. boscas (Wild Duck)...	19	49	217
A. cristata (Crested ,,)...	2	72·5	112
A. obscura (Dusky ,,)...	5	93	146
A. pœcilorhyncha (Spot-billed ,,)...	37	33	127

ANATINÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Anas specularis (White-marked Duck)	1	11	11
A. superciliosa (Australian Wild ,,)	45	42	190
A. undulata (Yellow-billed ,,)	8	85	319
Chaulelasmus streperus (Gadwall)	10	50·5	122
Mareca penelope (Wigeon)	41	59·5	155
M. sibilatrix (Chiloe Wigeon)	37	48	185
Dafila acuta (Pintail)	21	55	214
D. spinicauda (Chilian Pintail)	67	40·5	273
Pœcilonetta bahamensis (Bahama Duck)	24	59·7	170
P. erythrorhyncha (Red-billed ,,)	1	128	128
Nesonetta aucklandica (Auckland Island Duck)	1	17	17
Querquedula, whole genus	192	45	208
Q. brasiliensis (Brazilian Teal)	34	39	126
Q. castanea (Chestnut-breasted Duck)	11	19	96
Q. circia (Garganey Duck)	43	45	164
Q. crecca (Common Teal)	43	52	152
Q. cyanoptera (Blue-winged ,,)	5	13·6	43
Q. falcata (Falcated ,,)	9	18	50
Q. flavirostris (Chilian ,,)	8	35	87
Q. formosa (Japanese ,,)	21	48	150
Q. gibberifrons (Slender Duck)	18	75	208
Spatula clypeata (Shoveller)	18	60	154
Marmaronetta angustirostris (Marbled Duck)	12	18	103
FULIGULINÆ.			
Metopiana peposaca (Rosy-billed Duck)	39	47	160
Fuligula, whole genus	82	42·5	193
F. baeri (Baer's Duck)	5	21	47
F. cristata (Tufted ,,)	23	40	125
F. ferina (Pochard)	21	60	193
F. ferruginea (White-eyed Duck)	1	1	1
F. marila (Scaup)	8	20	73
F. rufina (Red-crested Pochard)	24	39	144
Tachyeres cinereus (Steamer Duck)	1	15	15
Clangula glaucion (Golden-eye)	20	33	164
Œdemia nigra (Common Scoter)	1	30	30
Somateria mollissima (Eider Duck)	3	14	17
ERISMATURINÆ.			
Biziura lobata (Musk Duck)	2	2·5	3
MERGANETTINÆ.			
Hymenolæmus malacorhynchus (Soft-billed Duck)	4	35	72
MERGINÆ.			
Mergus albellus (Smew)	9	22	46
M. merganser (Goosander)	5	35	84
M. serrator (Red-breasted Merganser).	3	7	18

Mr. J. H. Gurney gives (*loc. cit.* p. 39) one doubtful case of a Wild Duck of 29 years, and several well authenticated examples of various ducks ranging from 23 years downwards. The figures of maximum duration on my list are almost uniformly high, the best being a Yellow-billed Duck of 26 years', a Chilian Pintail of nearly 23 years', and a Red-billed Tree-duck of over 20 years' duration. The figures of average duration are reduced in many cases by the inclusion of a number of very short-lived birds, either ducklings or new arrivals, but none the less show a fairly consistent high viability.

Summary of Anseres.

The first question that comes into special prominence in the case of Swans, Geese and Ducks is the validity of the units on which these averages are made. The individuality of these birds is difficult to distinguish, and as in the period to which the figures relate, there was no system of marking the individuals, mistakes must have been easy to make, where opportunity occurred. The swans, geese, and a good many of the larger ducks, such as Sheldrakes, were kept in separate pens, and the chances of confusing individuals were very small. In the case of birds like the Mandarins, Summer Ducks, Wild Duck, Pintail, Teal, and so forth, a good many were kept in the same ponds, and mistakes as to individuals must have taken place. However, the numbers at any particular time during the whole period of 33 years were never very large; and if the figures of cases where individuals were very few and were kept separate be compared with those where confusion was more likely, the inference can be drawn fairly, that on the whole such mistakes have corrected each other, and that the results are fairly valid.

It is to be noticed that the familiar correlation between size and longevity does not appear in these figures of Anserine birds, although it may apply to potential longevity. There is very little to choose between the ducks and geese, and both ducks and geese on the whole show higher maximum and average durations than occur for swans. In all the Anseres the alimentary canal is relatively long, arranged in a somewhat complex fashion, and narrow in calibre; the hind-gut and cæca are, in comparison with most other birds, rather long, and capacious (except in the Mergansers, where the cæca are vestigial). They are highly intelligent birds, readily adapting themselves to new conditions and realizing quickly that they have nothing to fear from man. Except that the space given to Swans has been rather limited, the conditions have been good, as these birds, whether from the tropics or not, have been invariably given access to open air, and in most cases have spent their whole time in it. The figures of average and maximum duration show that these birds have a good viability in captivity. None the less, as the conditions are rather unusually favourable, I think the inference can be drawn that, in proportion to their size, Anseres have not naturally very high longevity or viability.

Capt. Flower records only one example of the Anseres—an Egyptian Goose—still alive after 12 years.

COLUMBÆ.

TRERONIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Sphenocercus sphenurus (Wedge-tailed Pigeon).	1	35	35
Vinago, whole genus	7	6·4	9
V. calva (Bare-faced Fruit-Pigeon)	5	6	9
V. crassirostris (Thick-billed ,,) ...	1	4	4
V. delalandii (Delalande's ,,) ...	1	9	9
Crocopus chlorogaster (Southern Fruit-Pigeon)	1	34	34
C. phœnicopterus (Purple-shouldered Fruit-Pigeon).	1	5	5
Osmotreron bicincta (Double-banded Fruit-Pigeon).	1	4	4
O. vernans (Parrot ,, ,,)	2	10	14
Ptilopus, whole genus.....................	9	5·5	22
P. fasciatus (Banded Fruit-Pigeon) ...	2	1	1
P. jambu (Jambu ,, ,,)...	4	6·5	22
P. melanocephalus (Black-headed Fruit-Pigeon).	2	10	11
P. porphyraceus (Purple-crowned Fruit-Pigeon).	1	1	1
Globicera, whole genus	5	24	65
G. auroræ (Aurora Island Fruit-Pigeon)	1	65	65
G. pacifica (Pacific ,, ,,)	2	8·5	9
G. rufigula (Vinous-throated Fruit-Pigeon).	2	18·5	26
Carpophaga ænea (Bronze Fruit-Pigeon)	10	23·7	53
C. paulina (Red-naped ,, ,,)	4	27	41
Myristicivora luctuosa (Nutmeg Fruit-Pigeon).	4	14	16
Lophœmus antarcticus (Double-crested Fruit-Pigeon).	17	13	25
COLUMBIDÆ.			
Columba, whole genus	138	34·7	227
C. albigularis (White-throated Violet Pigeon).	1	9	9
C. araucana (Araucanian ,,)	1	25	25
C. bollii (Bolle's ,,)	6	22	65
C. caribbæa (Ring-tailed ,,)	1	56	56
C. eversmanni (Eversmann's ,,)	1	68	68
C. guinea (Triangular-spotted ,,)	27	23	53
C. gymnophthalma (Naked-eyed ,,)	2	114	144
C. inornata (Cuban ,,)	1	40	40

Columbidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Columba laurivora (Canary Pigeon)	4	24	37
C. leucocephala (White-crowned ,,)	10	40	79
C. leuconota (White-backed ,,)	20	33·5	80
C. maculosa (Spotted ,,)	8	43	100
C. œnas (Stock-Dove)	4	13	19
C. palumbus (Ring-Dove)	10	18	37
C. picazuro (Picazuro Pigeon)	7	62	166
C. plumbea (Vinaceous ,,)	5	45	227
C. rufina (Rufous ,,)	1	30	30
C. speciosa (Specious ,,)	12	19	42
C. squamosa (Porto Rico ,,)	17	45	215
Macropygia leptogrammica (Narrow-barred Pigeon).	3	9	13
M. phasianella (Pheasant-tailed ,,)	2	12	23
Ectopistes migratorius (Passenger Pigeon).	6	23	76
Zenaidura carolinensis (Carolina Dove)	2	8	8
Zenaida, whole genus	48	25·2	80
Z. amabilis (Zenaida Dove)	8	25	33
Z. auriculata (Auriculated Dove)	17	27·6	79
Z. aurita (Martinican ,,)	23	23	80
Nesopelia galapagoensis (Galapagan Dove).	4	16·5	29
Melopelia leucoptera (White-winged Zenaida Dove).	2	16·5	17
Turtur, whole genus	139	25·5	195
T. aldabranus (Aldabra Turtle Dove)	3	11	19
T. bitorquatus (Double-ringed Turtle Dove).	1	62	62
T. capicola (Cape Turtle Dove)	2	8	10
T. chinensis (Chinese ,, ,,)	8	41	77
T. communis (Turtle Dove)	18	20·5	82
T. orientalis (Eastern Turtle Dove)	5	51	195
T. risorius (Barbary ,, ,,)	34	22	108
T. semitorquatus (Half-collared Turtle Dove).	17	36	170
T. senegalensis (Cambayan Turtle Dove)	20	34	145
T. suratensis (Spotted ,, ,,)	11	34	75
T. tigrinus (Tigrine ,, ,,)	1	41	41
T. vinaceus (Vinaceous ,, ,,)	19	52·5	177
Geopelia, whole genus	84	28·5	80
G. cuneata (Graceful Ground-Dove)	22	25	80
G. humeralis (Barred-shouldered Dove)	19	28	72
G. maugæi (Maugé's Dove)	6	44	60
G. striata (Barred ,,)	23	33	80
G. tranquilla (Peaceful ,,)	14	20	47
Scardafella squamosa (Scaly Ground-Dove).	10	16	40
Columbula picui (Picui Dove)	6	6	10

Columbidæ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Chamæpelia passerina (Passerine Ground-Dove).	5	11·8	27
C. talpacoti (Talpacoti ,, ,,)	16	30	67
Peristera geoffroyi (Geoffroy's Dove)	34	26·5	102
Metriopelia melanoptera (Black-winged Dove).	8	29·5	121
Œna capensis (Cape Dove) …………	11	28	69
Tympanistria bicolor (Tambourine Pigeon).	16	26	61
Chalcopelia chalcospilos (Bronze-spotted Dove).	17	37·5	92
Chalcophaps chrysochlora (Little Green-winged Dove).	5	32	61
C. indica (Green-winged Dove)………	23	35	193
Calopelia puella (Schlegel's ,,)………	18	21	109
Phaps, whole genus …………………	38	24·5	98
P. chalcoptera (Bronze-winged Pigeon)	34	24	98
P. elegans (Brush ,, ,, ,,)	3	20	28
P. histrionica (Harlequin Bronze-winged Pigeon).	1	60	60
Geophaps plumifera (Plumed Ground-Dove).	9	26	66
G. scripta (Partridge Bronze-winged Pigeon).	5	16	24
Ocyphaps lophotes (Crested Pigeon) …	49	22	64
Haplopelia larvata (Rufous-necked Wood-Dove).	2	14	16
Leptoptila, whole genus ………………	16	28	103
L. jamaicensis (White-fronted Dove)	5	40	103
L. ochroptera (Orange-winged ,,)	2	11	14
L. rufaxilla (Red-under-winged ,,)	9	25	81
Geotrygon, whole genus ………………	22	27	56
G. cristata (Mountain-witch Ground-Dove).	4	17	25
G. montana (Red Ground-Dove) ……	14	30	56
G. mystacea (Moustache Ground-Dove)	4	29	54
Phlogœnas luzonica (Blood-breasted Pigeon).	29	24	79
P. stairi (Stair's Ground-Dove)………	2	14·5	18
Leucosarcia picata (Wonga-Wonga Pigeon).	22	50	171
Starnœnas cyanocephala (Blue-headed Pigeon).	13	20	44
Calœnas nicobarica (Nicobar ,,)	23	51	109
Goura coronata (Common Crowned Pigeon).	30	23	110
G. victoriæ (Victoria Crowned ,,)	10	58	142
Didunculus strigirostris (Toothed-billed Pigeon).	3	30	53

Summary of Columbæ.

Mr. J. H. Gurney (*loc. cit.* p. 39) gives on the authority of Mr. F. E. Blaauw several instances of long-lived Collared Doves (*Turtur risorius*), ranging from 40 to 30 years, and a Common Pigeon of 28½ years; a correspondent of my own, Mr. E. Mellin, has informed me of a Ring-Dove of over 23 years old. The figures of maximum duration on my list are therefore not surprising: they include a Vinaceous Pigeon of just under 19 years, a Porto Rico Pigeon of just under 18 years, an Eastern Turtle-Dove and a Green-winged Dove of over 16 years. The maximum durations are on the whole good; certainly in proportion to size better than in the Anseres. The figures of average duration are much lower in the Fruit Pigeons, in which they seldom exceed 2 years and are frequently under 1 year, than in the Columbidæ, where they mostly range from 2 to 5 years. I cannot see any good correlation within the group, between size and viability.

Pigeons have a long and complex alimentary tract, with, however, the posterior portion and cæca relatively much reduced. They have been kept under various conditions in the period under discussion, but most of the tropical forms have been placed in a heated aviary, sometimes with, sometimes without access to the open air.

Capt. Flower's highest record is that of a Green-winged Dove, alive after 6 years' duration.

PTEROCLETES.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Pterocles, whole genus......................	67	20·5	94
P. alchata (Pin-tailed Sand-grouse) ...	18	15	34
P. arenarius (Black-bellied Sand-grouse).	27	21	55
P. bicinctus (Double-banded Sand-grouse).	9	17	32
P. exustus (Little Pin-tailed Sand-grouse).	11	31	94
P. fasciatus (Banded Sand-grouse)	1	24	24
P. namaqua (Namaqua ,, ,,)	1	15	15
Syrrhaptes paradoxus (Pallas' Sand-grouse).	16	8	14

I had no previous information as to the longevity of Sand-grouse. The maximum durations, of which the highest is under 8 years, and the average durations, most of which are considerably less than 2 years, show that these birds, in proportion to their size, are less viable than Doves and Pigeons. Their alimentary tract is somewhat similar to that of Pigeons, but the hind-gut and cæca are relatively capacious. In the period under consideration Sand-grouse were placed in an aviary with heated interior and open-air runs.

Capt. Flower records Spotted Sand-grouse (*P. senegallus*) still alive after over 9 years' duration; a year longer than the highest record I give.

GALLINÆ.

Tetraonidæ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tetrao, whole genus	11	9·7	50
T. cupido (Prairie Grouse)	7	5·5	17
T. phasianellus (Sharp-tailed Grouse).	2	26	50
T. urogallus (Capercaillie)	2	8·5	15
Phasianidæ.			
Galloperdix, whole genus	5	18·6	64
G. lunulata (Hardwicke's Spur-fowl).	1	1	1
G. spadicea (Rufous ,, ,,).	2	44·5	64
G. zeylonensis (Ceylonese ,, ,,).	2	1·5	2
Ithaginis geoffroyi (Geoffroy's Blood-Pheasant).	1	14	14
Ptilopachys ventralis (Buff-breasted Partridge).	2	27·5	31
Francolinus, whole genus	68	15	62
F. bicalcaratus (Double-spurred Francolin).	7	6 5	21
F. capensis (Cape Francolin)	1	4·2	4
F. clappertoni (Clapperton's Francolin).	8	30·5	54
F. coqui (Coqui ,,).	5	18·8	32
F. granti (Grant's ,,).	2	21·5	26
F. gularis (Wood ,,).	3	18·6	36
F. kirki (Kirk's ,,).	2	3·5	4
F. levaillanti (Levaillant's ,,).	1	7	7
F. natalensis (Natal ,,).	1	1	1
F. pictus (Painted ,,).	1	10	10
F. ponticerianus (Grey ,,).	19	17	62
F. vulgaris (Black ,,).	18	11	43
Pternistes, whole genus	29	15·8	51
P. afer (Grey-winged Francolin)	7	12	22
P. infuscatus (Dusky ,,)	1	18	18
P. leucoscepus (White-shafted ,,)	7	7	24
P. nudicollis (Bare-necked ,,)	7	26	51
P. swainsoni (Swainson's ,,)	7	16	23
Arboricola atrogularis (Black-throated Francolin).	1	9	9
A. torqueola (Hill Francolin)	5	19	62
Bambusicola fytchii (Fytch's Francolin).	1	19	19
B. thoracica (Bamboo Partridge)	15	24	80
Perdix cinerea (Partridge)	14	14	28
P. hodgsoniæ (Hodgson's Partridge)	4	16	24
Coturnix, whole genus	108	22·3	85
C. chinensis (Chinese Quail)	23	19	41
C. communis (Common ,,)	54	22	85
C. coromandelica (Rain ,,)	15	27	59
C. histrionica (Harlequin ,,)	12	21	40
C. pectoralis (Pectoral ,,)	4	25	34

PHASIANIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Synœcus australis (Australian Quail)	10	26·7	57
Perdicula argoondah (Marbled ,,)	1	28	28
P. asiatica (Asiatic ,,)	10	12·4	27
Rollulus cristatus (Crowned ,,)	8	9	20
Odontophorus dentatus (Capoeira ,,)	9	9·9	29
O. guianensis (Guiana ,,)	8	7·4	17
Ortyx virginianus (Virginian Colin)	11	11	38
Eupsychortyx cristatus (Crested ,,)	27	14	58
E. leylandii (Leyland's Colin)	1	43	43
Callipepla, whole genus	72	18	91
C. californica (Californian Quail)	57	17	91
C. gambelli (Gambel's ,,)	7	26	49
C. squamata (Mexican ,,)	8	18	46
Caccabis, whole genus	59	12	50
C. chukar (Chukar Partridge)	27	11	50
C. melanocephala (Black-headed Partridge).	3	9	20
C. petrosa (Barbary Partridge)	10	13	50
C. rufa (Red-legged ,,)	10	9·5	31
C. saxatilis (Greek ,,)	9	15	32
Ammoperdix bonhami (Bonham's Partridge).	3	20	41
A. heyi (Hey's Partridge)	2	15·5	19
Tetraogallus himalayensis (Himalayan Snow Partridge).	1	3	3
Lophophorus, whole genus	56	23·6	123
L. impeyanus (Himalayan Monaul)	54	23	123
L. lhuysi (Lhuys's ,,)	1	54	54
L. sclateri (Sclater's ,,)	1	20	20
Crossoptilon mantchuricum (Mantchurian Crossoptilon)	20	22·8	42
C. tibetanum (Tibetan ,,)	7	22	32
Phasianus, whole genus	174	25·5	95
P. colchicus (Common Pheasant)	11	26	85
P. decollatus (Collarless ,,)	1	18	18
P. ellioti (Elliot's ,,)	32	32	76
P. principalis (Prince of Wales's ,,)	4	18	46
P. reevesi (Bar-tailed ,,)	57	22·8	64
P. sœmmerringi (Sœmmerring's ,,)	9	36	95
P. torquatus (Ring-necked ,,)	16	20	70
P. versicolor (Japanese ,,)	27	20	86
P. wallichii (Cheer ,,)	17	31	79
Thaumalea amherstiæ (Lady Amherst's Pheasant)	87	20	97
T. picta (Gold Pheasant)	75	22·5	93
Pucrasia, whole genus	21	8·6	24
P. darwini (Darwin's Pucras)	19	9	24
P. macrolopha (Indian ,,)	1	3	3
P. xanthospila (Yellow-spotted ,,)	1	4	4

PHASIANIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Euplocamus, whole genus	155	24·8	161
E. albo-cristatus (White-crested Kaleege)	12	36	76
E. andersoni (Anderson's ,,)	1	11	11
E. erythrophthalmus (Rufous-tailed Pheasant)	18	20	109
E. horsfieldi (Purple Kaleege)	7	46	108
E. lineatus (Lineated ,,)	19	22	76
E. melanotus (Black-headed ,,)	8	45	161
E. nycthemerus (Silver Pheasant)......	38	23	114
E. nobilis (Fire-back ,,)......	8	37	116
E. prælatus (Siamese ,,)......	8	40	111
E. swinhoii (Swinhoe's ,,)......	32	12	66
E. vieilloti (Vieillot's Fire-back)	4	11	21
Gallus, whole genus	39	22·7	148
G. bankiva (Bankiva Jungle-fowl)...	5	8	36
G. sonnerati (Sonnerat's ,, ,,)...	12	31	148
G. stanleyi (Ceylonese ,, ,,)...	11	18	36
G. varius (Fork-tailed ,, ,,)...	11	23	62
Ceriornis, whole genus	71	29	133
C. blythi (Blyth's Tragopan)	5	38	133
C. caboti (Cabot's ,,)	6	31	72
C. melanocephala (Black-headed Tragopan)	2	26·5	28
C. satyra (Horned ,,)	21	19	58
C. temmincki (Temminck's ,,)	37	30·5	123
Pavo, whole genus	99	22·6	98
P. cristatus (Common Peafowl)	66	24	98
P. nigripennis (Black-winged ,,)	15	26	73
P. spicifer (Javan ,,)	18	13	47
Polyplectron, whole genus	47	50	179
P. bicalcaratum (Crested Peacock Pheasant)	2	23	41
P. chinquis (Peacock Pheasant)	39	55	179
P. germaini (Germain's Peacock Pheasant).	6	22	47
Argus giganteus (Argus Pheasant).	22	42	163
Meleagris gallopavo (North American Turkey).	12	26	62
M. ocellata (Ocellated Turkey)	2	2·5	3
Numida, whole genus	34	17·7	40
N. ellioti (Elliot's Guinea-fowl)	1	5	5
N. meleagris (Common ,, ,,)	8	28	40
N. mitrata (Mitred ,, ,,)	11	16	30
N. ptilorhyncha (Abyssinian ,, ,,)	13	14	40
N. reichenowi (Reichenow's ,, ,,)	1	17	17
Guttera, whole genus	23	16	54
G. cristata (Crested Guinea-fowl)	12	17	54
G. édouardi (Verreaux's ,, ,,)	1	21	21

PHASIANIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Guttera pucherani (Pucheran's Guinea-fowl).	10	14·4	28
Acryllium vulturinum (Vulturine Guinea-fowl).	34	20	101
CRACIDÆ.			
Crax, whole genus	83	46·8	124
C. alberti (Prince Albert's Curassow)	11	47	104
C. alector (Crested ,,)	13	40	118
C. carunculata (Yarrell's ,,)	12	46	106
C. daubentoni (Daubenton's ,,)	12	40·7	93
C. globicera (Globose ,,)	19	40·7	119
C. globulosa (Globulose ,,)	2	59	103
C. incommoda (Inconvenient ,,)	2	29	50
C. sclateri (Sclater's ,,)	12	62	124
Mitua tomentosa (Lesser Razor-billed Curassow).	4	68	133
M. tuberosa (Razor-billed ,,)	7	71·7	139
Pauxis galeata (Galeated ,,)	3	70	102
Nothocrax urumutum (Urumutum Curassow).	3	37	49
Penelope, whole genus	50	32	105
P. cristata (Rufous-vented Guan)	14	27	82
P. greeyi (Greey's ,,)	2	15	20
P. jacucaca (White-fronted ,,)	11	34	65
P. marail (Marail ,,)	1	18	18
P. pileata (Red-breasted ,,)	3	50	63
P. purpurascens (Purplish ,,)	7	38	77
P. superciliaris (White-eyebrowed ,,)	12	32	105
Pipile, whole genus	7	23	37
P. cujubi (Amazonian Guan)	3	30	37
P. cumanensis (Piping Guan)	3	20	27
P. jacutinga (White-crested ,,)	1	12	12
Alburria carunculata (Wattled ,,)	2	21	21
Ortalis, whole genus	20	26·5	100
O. albiventris (White-bellied Guan)	8	27	100
O. garrula (Chattering ,,)	1	66	66
O. motmot (Little ,,)	4	7·5	19
O. ruficauda (Red-tailed ,,)	3	28	50
O. vetula (Mexican ,,)	4	32	39
MEGAPODIIDÆ.			
Talegalla lathami (Brush-Turkey)......	13	59	236
Megacephalon maleo (Great-headed Maleo).	3	5	9
Leipoa ocellata (Mallee Bird)...........	1	24	24

Summary of Gallinæ.

Mr. J. H. Gurney (*loc. cit.* p. 39) gives a few interesting figures for Gallinaceous birds, including domestic fowls of 30, 25 and 24 years, and a Silver Pheasant of 21 years. The maximum durations on my list include some fairly high figures—a Brush-Turkey of over 19 years, a Peacock Pheasant of nearly 15 years, Argus and Kaleege Pheasants over 13 years, a Monaul of over 10 years and a Common Quail of over 7 years. Taking Gallinæ as a whole there is no close correlation between size and duration. The Grouse are the least viable in captivity, the average durations being nearly all under a year, and 4 years being the maximum. The Francolins, Quails, and Partridges have an average duration most often between 1 and 2 years, with a few good figures of maximum duration. The Pheasants, Peacocks, and Jungle-Fowl for the most part have average durations exceeding 2 years, and reach 13 to 15 years maximum. Sir E. G. Loder, Bt., F.Z.S., however, has told me of a Peacock still alive at a house near Aylesbury, and which is certainly 40 years old. The Curassows and Guans appear to be specially viable; there is a remarkable uniformity amongst the individual durations, these lying very close to the average, which is generally over 3 years.

The structure of the intestinal tract does not differ much in Gallinaceous birds: in all the gut is relatively capacious, although not specially long, and the posterior portion including the cæca is long and capacious compared to the whole gut. It is perhaps not more than a coincidence that the hind-gut and cæca are relatively least capacious in the Megapodes, next least capacious in the Curassows, and most capacious in the other Gallinaceous birds, whilst the Megapodes show the best maximum duration, and the Curassows the highest average durations in the group. The conditions under which the birds of this group were kept during the period in question did not differ much; all had access to open air, and the smaller Quails, Partridges and so forth, and the Curassows had warmed shelters, whilst the others had unheated sheds. Considering the more or less favourable conditions, and the large size of many of the Gallinaceous birds, it cannot be said that they display a good constitutional viability.

Capt. Flower's records are closely comparable with the maxima I give here. He notes a Clapperton's Francolin still alive after 6 years, my highest record being 5 years; a Quail of over 7 years, the same maximum as mine; an Amherst Pheasant of 11 years' duration, and a Silver Pheasant still alive after 12 years; these are higher than the records of the same species I quote, but, on the other hand, I cite a Black-headed Kaleege of 13 years and a Peacock Pheasant of 15 years.

HEMIPODII.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Turnix, whole genus	15	9	26
T. dussumieri (Little Bittern Quail)...	2	2·5	4
T. lepurana (Lepurana Hemipode) ...	3	17	26
T. sykesi (Sykes's ,,) ...	2	8	16
T. taigoor (Black-breasted ,,) ...	2	1	1
T. tanki (Tipperah ,,) ...	2	1	1
T. varia (Varied ,,) ...	4	16	25

I am ignorant of any figures hitherto recorded as to the longevity of Hemipodes. My figures show a very low viability both from the point of view of average and maximum durations. The birds were kept during the period dealt with under the same conditions as the small Francolins, Quails and Partridges. The alimentary tract is relatively short but capacious, the hind-gut and cæca being very capacious relatively to the size of the birds. The group has a low viability.

FULICARIÆ.

RALLIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Rallus, whole genus	24	21·3	51
R. aquaticus (Water-Rail)..	10	13·9	35
R. celebensis (Celebean Rail)	3	36	48
R. maculatus (White-spotted Rail) ...	3	26	48
R. pectoralis (Australian ,,) ...	6	19·5	35
R. rhytirhynchus (Sooty ,,) ...	2	36	51
Aramides cayennensis (West-Indian Rail)	19	10	26
A. ypecaha (Ypecaha Rail)	11	15·5	39
Porzana, whole genus	5	30	59
P. carolina (Carolina Crake)	2	22·5	28
P. maruetta (Spotted ,,)	2	29	29
P. notata (Marked ,,)	1	59	59
Rallina pœciloptera (Bar-winged Rail)	1	2	2
Crex pratensis (Corn Crake)	16	22	101
Ocydromus, whole genus	30	52	117
O. australis (Weka Rail)	17	49	117
O. earli (Earl's ,, ,,)	8	64	107
O. fuscus (Black Woodhen)	1	50	50
O. lafresnayanus (New Caledonian Rail)	2	43·5	76
O. sylvestris (Woodhen Rail)............	2	38·5	66
Limnocorax niger (Black Gallinule)...	2	52·5	89
Porphyrio, whole genus..................	53	23·5	75
P. calvus (Javan Porphyrio)	1	1	1
P. cæruleus (Purple Gallinule).........	4	21	32
P. edwardsi (Milne Edwards's Porphyrio)	2	18·5	22
P. madagascariensis (Madagascar Porphyrio)	17	18	59
P. melanotus (Black-backed ,,)	19	25	73
P. poliocephalus (Grey-headed ,,)	9	32	75
P. vitiensis (Grey-blue ,,)	1	23	23
Hydrornia alleni (Allen's ,,)	13	17	47
Ionornis martinicus (Martinique Gallinule)	8	17	30
Tribonyx mortieri (Mortier's Water-hen).	1	102	102
T. ventralis (Black-tailed Waterhen).	3	85	162

RALLIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Gallinula, whole genus	20	25·5	42
G. chloropus (Moorhen)	9	30	42
G. galeata (American Moorhen)	2	21	29
G. nesiotis (Island-Hen Gallinule)	3	25	35
G. phœnicura (White-breasted ,,)	4	12·5	26
G. pyrrhorhoa (Madagascar Moorhen)	2	38·5	42
Fulica, whole genus	8	14	36
F. ardesiaca (Slaty Coot)	2	18·5	36
F. atra (Coot)	4	16	21
F. leucoptera (Strickland's Coot)	2	6	9

Summary of Fulicariæ.

I have discovered few published statements as to the longevity of Rails and Crakes, but Mr. J. H. Gurney (*loc. cit.* p. 38) has mentioned Porphyrios of 19 and 14 years. The highest figure on my list is that for a Black-tailed Waterhen with a duration of over 13 years; then come a Weka Rail of over 9 years; a Corn Crake of 8 years, and then figures ranging downwards. The average durations range rather closely round 2 years. The intestinal tract of Rails and their allies is of moderate length and capacity, the posterior portion with the cæca being rather capacious. These birds in the period in question have been kept either in open-air paddocks, or in an aviary with heated interior and access to open air. There is not a very wide gap between the figures of average and maximum durations; there is no appreciable correlation between size and longevity, and considering the rather favourable conditions under which the birds were kept, they appear to have a rather low viability in proportion to their size.

Capt. Flower's highest record is a Gallinule still alive after 6 years' duration.

ALECTORIDES.

OTIDIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Otis tarda (Great Bustard)	16	30	128
Eupodotis, whole genus	13	50·7	106
E. arabs (Arabian Bustard)	2	59	91
E. australis (Australian ,,)	4	73	106
E. caffra (Kaffir ,,)	1	9	9
E. denhami (Denham's ,,)	3	60	98
E. kori (Burchell's ,,)	2	24	42
E. ruficollis (Red-necked ,,)	1	10	10
Houbara macqueeni (Macqueen's Bustard)	8	9	25
H. undulata (Houbara Bustard)	7	3	9

I have found no other figures published as to the longevity of Bustards. The maximum duration on my list, of nearly 11 years for a Great Bustard, is no great age for so large a bird; the figures of average duration are fairly good in comparison with the maximum durations. These birds have been kept almost altogether in open-air paddocks, and it would appear that their constitutional viability is not high in proportion to their size. The whole alimentary tract is very short in proportion to the size of the birds, but the hind-gut and cæca are relatively extremely capacious.

Psophiidæ & Cariamidæ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Psophia, whole genus	30	17·7	90
P. crepitans (Common Trumpeter) ...	15	17·5	90
P. leucoptera (White-backed ,,) ...	6	19·5	34
P. viridis (Green-winged ,,) ...	9	16·5	32
Cariama cristata (Brazilian Cariama)	20	49	151
Chunga burmeisteri (Burmeister's Cariama).	6	31	65

I do not know of any published references to the ages of Trumpeters and Cariamas. The alimentary tract of these birds is much of the same character as that of the Bustards, but the cæca and hind-gut are relatively rather less capacious. The birds have been kept in an aviary with heated interior and open-air compartments. The record of between 12 and 13 years for a Brazilian Cariama, and the figures of average duration appear to show that the Cariamas have a higher viability than the Trumpeters. The former are larger birds, and the difference may be merely the familiar size correlation.

Gruidæ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Grus, whole genus	42	72	514
G. americana (American Crane)	5	34	82
G. antigone (Eastern Sarus ,,)	7	64	191
G. australasiana (Australian Crane)	10	68	129
G. canadensis (Canadian ,,)	4	35	96
G. communis (Common ,,)	7	145	514
G. japonensis (Mantchurian ,,)	8	59	306
G. monachus (Hooded ,,)	1	99	99
Anthropoides, whole genus...............	40	46·5	227
A. carunculata (Wattled Crane)	9	34	59
A. leucauchen (White-necked Crane)	1	184	184
A. leucogeranos (Asiatic White ,,)	9	34	84
A. paradisea (Stanley ,,)	8	58	227
A. virgo (Demoiselle ,,)	13	46	104
Balearica pavonina (Crowned ,,)	7	50	141
B. regulorum (Cape ,,)	14	43	170

Mr. J. H. Gurney has recorded (*loc. cit.* p. 38) a Common Crane of 40 years (from the Gardens of this Society) and a White-necked Crane of 28 years from the Amsterdam Gardens. The longest duration on my list is a Common Crane which lived in the Gardens for nearly 43 years, another of the same species with a duration of 27½ years, and a Mantchurian Crane of 25½ years. It is clear that these large birds have a very high potential longevity. The alimentary tract is relatively very long and of narrow calibre, but the cæca and hind-gut are by no means capacious in proportion to the whole tract. In the period to which the figures relate, the Cranes were kept in an open-air paddock, a few being taken indoors in winter. The maximum durations, and the average durations, ranging from nearly three years upwards, show that these birds have a high viability.

EURYPYGIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Eurypyga helias (Sun-bittern)	11	48	114
Rhinochetus jubatus (Kagu)	6	137	196

I do not know of any published figures relating to the longevity of the isolated birds here placed together. The individual examples of the Sun-bittern differed considerably in duration: all but one of the six Kagus lived at least 9 years in the Gardens, the maximum duration being over 16 years. They were kept under similar conditions, in an aviary with warmed retreats and access to open air. The maximum durations and average durations show that both have a high potential longevity and viability in proportion to their size, but that the Kagu is hardier than the Sun-bittern. In each case the alimentary tract is, relatively to the size of the bird, rather long, but the posterior region and cæca are uncapacious.

ARAMIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Aramus scolopaceus (Scolopaceous Coulan).	1	9	9

I cannot draw any conclusion from the single example of this bird. From the structure of the alimentary tract, I am disposed to regard this bird as less viable than Cranes, Bustards, Sun-bitterns and so forth.

Summary of Alectorides.

Most naturalists would agree that the association of the birds here grouped as Alectorides (following the Society's Vertebrate List) is not intimate. It is quite plain that within the assemblage there is no good correlation between size and longevity and viability. The Cranes, it is true, show the longest durations and very good averages, but the Kagus, which are much smaller, are nearly as good, whilst the Bustards, which are large and bulky birds, are much worse. If we make, so to say, a correction for size, discounting the expected greater longevity of the larger forms, then the birds in the assemblage might be arranged as follows, in the order of good to less good viability—Kagus, Cranes, Sun-bitterns, Cariamas, Trumpeters, Bustards generally, and lowest of all Houbara Bustards.

LIMICOLÆ.

ŒDICNEMIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months
Œdicnemus, whole genus	31	18	117
Œ. bistriatus (Double-striped Thicknee)	4	63	117
Œ. grallarius (Australian ,,)	8	13	43
Œ. scolopax (Stone-Curlew)	11	10·8	23
Œ. superciliaris (Peruvian Thicknee)	8	19·8	53
CHARADRIIDÆ.			
Charadrius pluvialis (Golden Plover)	27	9	23
Squatarola helvetica (Grey ,,)	15	16·5	58
Ægialitis curonica (Little Ringed ,,)	2	40·5	55
Æ. hiaticula (Ringed ,,)	9	8	14
Eudromias morinellus (Dotterel)	1	6	6
Vanellus cayennensis (Cayenne Lapwing)	19	31	106
V. cristatus (=*vulgaris*) (Lapwing) ...	31	11	38
Sarciophorus pectoralis (Black-breasted Peewit)	7	71	170
Strepsilas interpres (Turnstone)	6	66·5	92
Hæmatopus niger (Black Oyster-catcher)	2	29	49
H. ostralegus (Oyster-catcher)	28	28	85
Glareola ocularis (Eye-marked Pratincole)	1	40	40
G. pratincola (Pratincole)	10	23·3	81
CHIONIDÆ.			
Chionis alba (Yellow-billed Sheathbill)	12	21	89
C. minor (Black-billed ,,)	2	24·5	27
SCOLOPACIDÆ.			
Recurvirostra avocetta (Avocet).........	9	13	64
Himantopus brasiliensis (Brazilian Stilt-Plover)	1	3	3
H. nigricollis (Black-necked Stilt)......	12	11·5	26
Scolopax rusticola (Woodcock)	6	16	67
Gallinago cœlestis (Snipe)	1	1	1
Tringa alpina (Dunlin)	55	6	42
T. canutus (Knot)	44	25	94
Machetes pugnax (Ruff)	5	17	50
Calidris arenaria (Sanderling)	1	8	8
Tringoides hypoleucus (Common Sandpiper)	4	21	37
Totanus calidris (Redshank)	19	15	71
T. fuscus (Spotted ,,)	1	35	35
Limosa ægocephala (Black-tailed Godwit)	4	12·5	24
L. lapponica (Bar-tailed Godwit)	3	7	19
Numenius, whole genus	25	31	180
N. arquata (Curlew)	20	21	80
N. femoralis (Pacific Curlew)...........	2	131	180
N. phæopus (Whimbrel)..................	3	32	41

Summary of Limicolæ.

Mr. J. H. Gurney (*loc. cit.* p. 40) records an Oyster-catcher of 30 years, and a Ruff of 10 years. The highest figures of maximum duration on my list are 15 years for a Pacific Curlew and over 14 years for a Black-breasted Peewit, but there is at present alive in the Gardens a Wattled Lapwing (*Lobivanellus lobatus*) which we have had for nearly 20 years, and an Oyster-catcher which we have had for 13 years. The average durations on the list are in most cases between 1 and 2 years. In the period in question these birds were kept in an artificially warmed aviary, with or without access to open air, the best figures relating to species usually kept in an aviary with open-air cages. The structure of the alimentary canal of these birds is on the same general type—relatively very long and of slender calibre, with in the less specialized forms the cæca and hind-gut relatively more capacious, but seldom conspicuously so. The usual failure with common European birds is noteworthy, and would appear still more clearly if I had not omitted from the figures numerous cases of individuals that lived less than a month at the Gardens. The evidence appears to show that in proportion to their size Limicolous birds have a high potential longevity, but that either their viability is constitutionally low, or the conditions of captivity are unfavourable to them.

Capt. Flower's highest record is a Lapwing still alive after 6 years' duration.

GAVIÆ.

STERCORARIIDÆ.	No. of. Indiv.	Av. dur. in months.	Max. dur. in months.
Stercorarius, whole genus	14	14·6	67
S. antarcticus (Antarctic Skua)	6	18	67
S. buffoni (Buffon's ,,)	1	2	2
S. crepidatus (Richardson's ,,)	2	1	1
S. pomatorhinus (Pomatorhine ,,)	5	19	47
LARIDÆ.			
Phaëthusa magnirostris (Great-billed Tern)	1	2	2
Gelochelidon anglica (Gull-billed ,,)	1	10	10
Sterna, whole genus	12	11·6	74
S. cantiaca (Sandwich Tern)	4	2·7	3
S. fluviatilis (Common ,,)	7	16	74
S. minuta (Little ,,)	1	16	16
Larus, whole genus	190	42·5	257
L. argentatus (Herring Gull)	34	27·8	99
L. atricilla (Laughing ,,)	6	26	50
L. brunneicephalus (Brown-headed Gull)	1	55	55
L. cachinnans (Yellow-legged Herring Gull)	11	77	230

LARIDÆ (*cont.*).	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Larus canus (Common Gull)	27	30·9	77
L. cirrhocephalus (Ashy-headed Gull)	3	47	94
L. dominicanus (Dominican ,,)	5	101	114
L. franklini (Franklin's ,,)	3	10	16
L. fuscus (Lesser Black-backed ,,)	11	32·8	97
L. gelastes (Arabian ,,)	1	10	10
L. glaucus (Glaucous ,,)	6	58·5	156
L. ichthyaëtus (Great Black-headed ,,)	2	6·5	7
L. leucopterus (Iceland ,,)	1	93	93
L. marinus (Greater Black-backed ,,)	8	74	187
L. novæ-hollandiæ (Jameson's ,,)	14	60	255
L. ridibundus (Black-headed ,,)	57	40	257
Pagophila eburnea (Ivory ,,)	5	20	55
Rissa tridactyla (Kittiwake)	18	10·5	55

Summary of Gaviæ.

Mr. J. H. Gurney (*loc. cit.* p. 40) mentions Herring Gulls of 44 and 21 years, Lesser Black-backed Gulls of 30 and 32 years, and a Great Skua of 24 years. The highest figures on my list are a Black-headed and a Jameson's Gull, each of over 21 years' duration—and a Yellow-legged Herring Gull of over 19 years' duration. Within the divisions there is no apparent correlation between size and either maximum or average durations. The Skuas and Terns lived on an average under 2 years, most of the Gulls more than 4 years. The Gulls were kept, during the period covered, in out-door aviaries, or if they were pinioned, in open paddocks. The alimentary tract of all the Gaviæ is relatively long and of narrow calibre : the cæca and hind-gut are very short and uncapacious except in the Skuas, when they are of moderate length. The group, in proportion to its size, shows only moderate longevity and viability.

Capt. Flower's only high record is that of a Lesser Black-backed Gull alive after 11 years' duration.

TUBINARES.

PUFFINIDÆ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Puffinus, whole genus	6	1·6	4
P. anglorum (Manx Shearwater)	3	2	4
P. kuhli (Cinereous Puffin)	2	1	1
P. major (Greater Shearwater)	1	1	1
Fulmarus glacialis (Fulmar)	4	10	38

I do not know of any published information as to the longevity of the Tubinares, and the fate of the few examples on my list is only sufficient to show that they have very bad lives in captivity.

PYGOPODES.

Colymbidæ.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tachybaptes fluviatilis (Little Grebe)	10	10·3	50
Æchmophorus major (Great ,,)	1	9	9
Podiceps cristatus (Crested ,,)	3	4·3	11
P. griseigena (Red-necked ,,)	1	1	1
Colymbus arcticus (Black-throated Diver)	1	1	1
C. glacialis (Great Northern ,,)	2	5·5	10
C. septentrionalis (Red-throated ,,)	6	5	12
Alcidæ.			
Alca torda (Razorbill)	12	9	54
Lomvia troile (Common Guillemot) ...	33	6	52
Uria grylle (Black ,,) ...	6	1	2
Fratercula arctica (Puffin)	11	5	16

In the case of this group also, I do not know of published information. The records I can give are very bad; of 86 examples the average duration is under a year, and in most cases much under a year, whilst the figures would have been still worse if I had included a considerable number of Little Grebes, Crested Grebes, Razorbills, and Puffins that failed to live a month. In all these birds the intestinal tract is of moderate length, in proportion to size; even in the Divers the cæca and hind-gut are uncapacious, whilst in the others they are vestigial. I am unaware of anything in the structure of these birds from which we might infer a constitutional lack of viability as compared with, for instance, Gulls, and the conditions under which the attempt has been made to keep them are similar. I think that their lack of viability in captivity must be partly psychological, and to be referred to the set of causes which lower the average duration in captivity of most of the familiar mammals and birds of Europe.

IMPENNES.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Aptenodytes pennanti (King Penguin)	9	3·6	11
Pygosceles tæniatus (Gentoo ,,)	8	2·5	7
Spheniscus, whole genus	29	17·5	135
S. demersus (Black-footed Penguin)...	24	20	135
S. humboldti (Humboldt's ,,)...	2	5	9
S. magellanicus (Jackass ,,)...	3	5	8
Eudyptes, whole genus	16	13·5	88
E. antipodum (Yellow - crowned Penguin)	2	6·5	12
E. chrysocome (Rock-hopper ,,)	6	12	58
E. pachyrhynchus (Wide-beaked ,,)	5	4	8
E. sclateri (Sclater's ,,)	3	37	88

In this group also I am unaware of published figures as to longevity. To the maximum of over 11 years' duration in the case of a Black-footed Penguin, I am able to add that of another example of the same species, now alive in the Gardens after a duration of 12½ years, whilst there are several of over 6 years. The average duration shewn by the records is bad, in all cases under two years, in most under one. Penguins have an excessively long and slender alimentary tract, but the hind-gut and cæca are vestigial. In the period under consideration they were kept for the most part in a house with artificial heat and without access to fresh air, but some of the larger forms had free access to open air and they were by no means the most successful. I think it must be inferred that these birds have a good potential longevity, but that their viability in captivity, at least, is low.

CRYPTURI.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Tinamus solitarius (Solitary Tinamou).	6	30	78
Crypturus, whole genus	24	12·7	66
C. noctiragus (Banded Tinamou) ...	10	13·4	45
C. obsoletus (Obsolete ,,) ...	4	1·7	4
C. tataupa (Tataupa ,,) ...	9	17	66
C. undulatus (Undulated ,,) ...	1	6	6
Rhynchotus perdicarius (Chilian Tinamou).	2	24·5	26
R. rufescens (Rufous Tinamou)	66	19·6	102
Nothura maculosa (Spotted Tinamou)	48	12	35

In the case of Tinamous, once more I am unaware of the existence of published records as to longevity. The maximum duration of 8½ years (in the case of a Rufous Tinamou) and the average durations, which in most cases are under 2 years, show that these birds are rather less viable than the Guans, with which they may be compared in size and to some extent in habits. They have been kept under similar conditions—in an aviary with warmed shelters and open-air compartments. The structure of the alimentary canal differs from that of Gallinaceous birds chiefly in the relative shortness and want of capacity of the whole tract and in the much greater relative capacity and length of hind-gut and cæca.

APTERYGES.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Apteryx, whole genus	22	48	240
A. australis (Kiwi)	1	97	97
A. haasti (Haast's Kiwi)	2	55·5	46
A. mantelli (Mantell's ,,)	9	50·5	240
A. oweni (Owen's ,,)	10	38·8	117

Mr. J. H. Gurney (*loc. cit.* p. 40) records an Australian Apteryx which died after having lived 20 years in our Gardens; this is probably the same specimen recorded in my list as a Mantell's Apteryx. Although the Kiwis are small if considered in comparison with Struthious birds, they are actually large birds, and the figures of maximum and average durations cannot be taken as showing that these birds have a high viability in proportion to their size. They are nocturnal, and have generally been confined in small shelters in a heated aviary. The alimentary tract is of slender calibre, and not long in proportion to the size of the bird, but the hind-gut and especially the cæca are extremely capacious.

CASUARII.*	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Casuarius, whole genus	72	30·8	186
C. casuarius (Common or Ceram Cassowary).	11	31	110
C. c. beccarii (Beccari's Cassowary) ...	7	16	24
C. c. sclateri (D'Albertis' ,,)...	1	20	20
C. c. salvadori (Salvadori's ,,)...	5	22·5	61
C. c. intensus (Blue-necked ,,)...	4	17	29
C. c. violicollis (Violet-necked Cassowary).	6	26	38
C. c. australis (Australian ,,)	5	64	186
C. bicarunculatus (Two-wattled Cassowary).	5	34	86
C. uniappendiculatus (One-wattled Cassowary).	10	13·9	43
C. u. occipitalis (Jobi Island One-wattled Cassowary).	1	10	10
C. u. aurantiacus (Eastern One-wattled Cassowary).	1	8	8
C. u. rufotinctus (Red-tinted One-wattled Cassowary).	2	21·5	26
C. philipi (Sclater's ,,)	1	31	31
C. papuanus (Westermann's ,,)	5	45	85
C. p. edwardsi (Milne-Edwards's Cassowary).	2	14	15
C. picticollis (Painted-necked ,,)	1	29	29
C. bennetti (Mooruk)	5	78	174
Dromæus novæ-hollandiæ (Emu) ...	5	13·4	29

Mr. J. H. Gurney (*loc. cit.* p. 40) has recorded an Emu of 28 years, and a Westermann's Cassowary of 26 years. The figures on my list are very much lower, the maximum duration being 15½ years for a Cassowary. In the period considered they were kept in a warmed house with open-air yards, but to what extent they were allowed free access to the yards, I am unable to say. The figures of average duration vary, but these and the maximum durations both show that at least under the conditions of captivity, Cassowaries and Emus have a low viability in proportion to their size. It is interesting to notice that the Emus, although larger than most of the Cassowaries, appear to be less viable. In the section on Struthiones which follows I refer to the conditions of the alimentary tract of these birds.

---

* [In the synonymy of the Cassowaries I have followed Mr. L. W. Rothschild, Trans. Zool. Soc. vol. xv. p. 109.]

STRUTHIONES.	No. of Indiv.	Av. dur. in months.	Max. dur. in months.
Struthio camelus (Ostrich)	25	15·4	56
S. molybdophanes (Somali Ostrich) ...	4	25	62
Rhea americana (Common Rhea) ...	51	15·5	80
R. darwini (Darwin's „) ...	6	9	12
R. macrorhyncha (Great-billed Rhea)	11	17·6	43

Metchnikoff (*op. cit.* p. 78) has collected some information as to the longevity of Ostriches and their allies, and has come to the conclusion that 35 years would be an extreme age to be attained by these gigantic birds. The figures on my list show much shorter maximum durations, whilst the figures of average duration are still lower. It is interesting to note, that taking Kiwis, Cassowaries, Emus, Rheas, and Ostriches together, not only is there no direct correlation between size and average and maximum durations, but the familiar relation is reversed. The smallest birds, the Kiwis, according to my tables, show the highest viability; next come the Cassowaries, whilst the Ostriches, much the largest birds, are lowest. In the Kiwi and Cassowary, the cæca and hind-gut, although moderately capacious, are not specially so in proportion to the remainder of the alimentary tract; whilst in the Rheas, Emus, and above all in the Ostrich, the hind-gut and cæca are relatively enormously long and capacious, out of all proportion to the condition in any other group of birds and recalling the structure of herbivorous mammals. In their case there is the maximum opportunity for intestinal putrefaction, and these large Struthious birds, in proportion to their size, appear to have the lowest viability of all birds. Capt. Flower's only high record is an Ostrich alive after 12 years' duration.

SUMMARY OF AVES.

Constitutional differences in Longevity.

Putting together the information so carefully collected by Mr. Gurney, which of course related to maximum durations and potential longevity, and the results which I record here, we can draw the conclusion that very real constitutional differences in viability and longevity exist amongst the different families of birds. The chief difficulty is to distinguish between low viability due to special conditions of captivity and constitutional low viability. It cannot be supposed that birds which are resident in Europe, or in England, have a lower constitutional viability than their congeners in more distant parts of the world, and yet, if we were to form conclusions as to the viability of such birds (or mammals) from the evidence given by captive examples, we should have to assign to them a very low position. So also insectivorous birds have usually a low viability in captivity, but this may well be due to the difficulty of providing them with suitable food. So also, if we were limited to knowledge of parrots under the usual conditions of a Parrot-house, we should have a very erroneous view of their potentialities.

Passerine birds are long-lived and hardy. Almost all of them have a potential longevity probably well over 20 years, and some of the larger forms may reach to over 60 years. The least hardy in captivity are Warblers, Tits, Pipits, Wagtails, Bulbuls, Orioles, Tanagers, and Larks. Tyrants, Bell-birds, and so forth, which are generally regarded as a lower grade of Passerines, appear less viable and shorter-lived.

Of Picarian birds, Colies, Hornbills, Motmots, Toucans, and Barbets have potential longevities approaching those of Passerines, but markedly lower, whilst their viabilities are relatively good; Woodpeckers, Kingfishers, Hoopoes, Bee-eaters, Rollers, Frogmouths, Cuckoos, and Touracous have much lower potential longevities and are less hardy. Owls have a potential longevity certainly extending to over 50 years, but their viability appears to be constitutionally low, their short average durations in captivity not depending altogether on any specially unfavourable conditions.

Parrots have a high potential longevity, certainly ranging well over 50 years. Their viability is almost certainly good, and their low average durations must be assigned to unfavourable conditions in captivity.

Diurnal birds of prey have potential longevities probably exceeding those of parrots. Their viabilities are better than those of Owls, the conditions in captivity being in neither case satisfactory.

Steganopodes have potential longevities ranging up to about 50 years, with very good viability; there seems no constitutional reason to assign a low viability to Gannets and Cormorants, and their treatment in captivity does not differ much from that of Pelicans. The actual figures show that they have had much lower average and maximum durations than Pelicans, but this most probably is to be associated with the failure in the case of many other European birds.

Herons, Storks, Spoonbills and Ibises appear to have a potential longevity of over 30 years, and a fairly good viability. Ibises appear to have a better viability than the other members of the group.

Flamingoes have a potential longevity certainly considerably over 20 years, and have a high viability in captivity.

Screamers appear to have rather low potential longevity and viability, certainly much lower than those of Flamingoes or Geese.

Swans, Ducks, and Geese have a longevity most probably going beyond 50 years, and appear to have a good viability.

Doves and Pigeons have a potential longevity certainly reaching to about 30 years and have a very good viability.

Sand-grouse apparently are considerably lower than Pigeons both in potential and average duration.

Gallinaceous birds have a potential longevity ranging about 20 years, and only a fair viability. Megapodes, Curassows, and Guans seem to be most hardy and the longest livers.

The Hemipodes have considerably lower potential longevity and viability than Gallinaceous birds of about the same size.

Rails, Crakes, Porphyrios, and Gallinules appear to have potential longevities of not more than about 20 years, and have relatively low viability.

Of the Alectorides, Cranes have a potential longevity almost certainly exceeding 50 years and a very good viability. Kagus have a still better viability and probably a somewhat similar potential longevity. Bustards are the lowest of the group both in longevity and viability.

Limicolous birds have a potential longevity which is high in proportion to their size and must be set down as at least about 30 years. Either their constitutional viability is low or the conditions of captivity are specially unfavourable to them.

Gulls and their allies certainly have a potential longevity of at least 30 years, but their viability, at least under the conditions of captivity, is relatively low.

Puffins, Divers, Guillemots, and so forth have so poor a viability in captivity that no conclusions can be drawn as to their potential longevity.

Penguins have a potential longevity of at least over 12 years, but their viability under the conditions of captivity, in the period covered by my records, is low.

Tinamous appear to have a low potential longevity, certainly not much over 12 years, and a relatively poor viability.

The potential longevity of Struthious birds is certainly under 50 years, and their viability is relatively low.

Longevity and Size.

A very summary inspection of the tables of figures I have given will show that for birds as a whole there is no constant relation between potential longevity and size. The correlation does not exist even if only size and actual longevity be taken. An Ostrich is much bigger than a Crow or a Parrot, and yet cannot attain so great an age. Nor does the correlation exist between size and viability, for if the same sets of birds be compared, it will be seen that the average expectation of life is much better in the case of the smaller birds. If, instead of absolute correlation, relative correlation be considered, the case is more striking. An Ostrich must be several hundred times larger and heavier than many birds which could outlive it, and which on the average do outlive it. If the comparison between birds and mammals be taken, it is equally clear that, apart from such a case as that of the whale for which a very great age is assumed, and that of man, there are many birds with potential longevities equal to those of the longest-lived mammals. Moreover, if the two Classes be compared from the point of view of longevity in proportion to size, the result is still more striking. On the whole, group by group, mammals are much larger than birds, herbivorous mammals than herbivorous birds, frugivorous mammals than frugivorous birds, omnivorous or carnivorous mammals than omnivorous or carnivorous birds. And yet, group by group, if the figures be compared, it becomes more and more obvious that birds approach and often surpass mammals in longevity and viability. Metchnikoff has already called attention to this difference and has associated it with the anatomical fact that the most striking difference between the alimentary tracts of mammals and birds is in the greater relative length, complexity and capacity of the hind-gut in the former group. The facts that mammals with relatively reduced and uncapacious hind-guts and cæca (such as the Carnivora) tend to have longer lives in proportion to their size, and that birds like the Struthious birds, which have relatively long and capacious hind-guts and cæca, have short lives in proportion to their size, still further confirm and support Metchnikoff's general proposition.

Within certain groups of birds the correlation between size and potential longevity appears to exist. It can be traced with more or less clearness in the case of Eagles, Owls, Passeres, and Picarian birds. But even in this limited fashion it is far from being universal. Probably Swans have a higher longevity than Ducks and Geese, but I cannot find any similar differences if Geese and Ducks be compared. Kagus appear to live as long as Cranes, Ibises better than Storks or Herons: there is no trace of the correlation in the case of Rails, or Pigeons or Gulls, and amongst Struthious birds the conditions are apparently reversed, and the Kiwi is hardier than the Ostrich.

I should hesitate to say that the differences in the constitutional longevities of birds could be associated universally with the structure of the alimentary canal, although there are some indications pointing in that direction. The Struthious birds and the Screamers have large and capacious hind-guts and cæca, and in proportion to their size have very short lives. Sand-grouse differ from Pigeons in having capacious cæca and have relatively shorter lives. Owls have large cæca, Eagles and their allies have vestigial cæca, and Owls in proportion to their size appear to have lower potential and average longevities.

Many large birds such as Eagles, Vultures, Pelicans, Flamingoes, and Cranes, can attain great ages, but similar ages can be attained by much smaller birds such as Parrots and Crows. In proportion to their size, it is quite clear that Passeres have the longest potential and average durations; and that Parrots, Pigeons, and Limicolous birds, similarly in proportion to size, come next. There are few generalizations more difficult to support with convincing argument than those which relate to the relative degrees of specialization to be assigned to natural groups of animals, but I think that many ornithologists would agree with me if I were to say that Passeres, Parrots, Pigeons, and Limicolous birds were relatively high types, standing far away from whatever we may imagine the primitive bird-type to have been. And I think that the most certain general conclusion which I may draw regarding the relative longevity and viability of the groups of birds is, that in proportion to size, longevity and viability increase with perfection of organization. The further a bird has advanced along the lines of evolution of the bird group, the more viable it is. No doubt shortening of the hind-gut, reduction of the number of eggs in a clutch, increased care of the young, may all be taken as stages in the perfection of the bird-type, and so have a general association with increased longevity, apart from any direct influence which any one of them may have.

Viability, Temperature, and Open Air.

I cannot see that there is any relation between the climate from which birds come and their viability in captivity. Nor would such a relation be expected on general grounds, for birds, by their covering of feathers and the perfection of their vascular and respiratory systems, are well adapted to resist exposure to changes in temperature. If food be abundant, and if there be protection from draught, they seem remarkably indifferent to the temperature of the air. The interpretation, however, of their viabilities is obscured by special factors which existed in the period with which the figures deal, and which exist in most menageries. The comparison that is to be desired is a direct contrast between the viabilities of birds kept in the interior of a warmed house, and birds kept with little or no artificial heat and free exposure to the open air. The numbers of species and of individuals usually kept in captivity is much greater in the case of birds than in the case of mammals, and from the smaller size of birds and their more gregarious habits, it is usually possible to keep numbers of individuals of the same or of different species in the same aviary. The most familiar contrast in the conditions under which birds are kept, is that between one or two individuals in a small cage in a warmed house, and considerable numbers of individuals in an aviary or enclosure giving room for exercise, and access to the open air. Now although many birds can be kept together, and are kept together, many casualties occur. A good deal of fighting and bullying takes place, and in practice, it is extraordinarily difficult to secure that every bird in the collection gets its due share of food, and is not worried by its messmates. Moreover, there is special danger of individuals which are affected by a communicable disease, or by parasites, infecting their healthy neighbours. Birds in separate cages avoid these evils; they are safe from bullying, they are properly fed, and if they are out of condition temporarily, have a chance of recovery. If we discount the very considerable advantage of protection that the Parrots obtained from their housing in separate cages, it will be seen from comparison of their average durations with their known high specific longevity, how poorly the device of keeping them in a heated house has answered. In a majority of cases, birds that have had free access to open air have lived in communities, and before judging of the advantage of fresh air, we have to discount the perils arising from their communal life. With these limitations and corrections, I think it is as clear an inference in the case of birds as in that of mammals, that making protection from temperature more important than the access to fresh air has failed in practice.

GENERAL SUMMARY.

(1) This memoir brings together the records of the duration of life in captivity of over 20,000 individual mammals and birds, and contains information which, so far as I can ascertain, has never before been set out systematically. The individual facts are imperfect, inasmuch as the sources did not record the age, or condition, of the individuals at the time of their reception in the Collection. The probable effect of these imperfections is to lower the figures both of average and of maximum duration. I hope to have shewn that from the point of view of exact knowledge and for practical reasons, it is important that those in charge of living animals should take steps to record such information as exactly as possible. Every individual should be observed for some time after its arrival, and the date when it is passed into the general collection as apparently in good condition should be recorded, whilst, if the exact age be unknown, it should be classified as infantile, adult, or aged. The houses, enclosures, or general conditions under which it is kept, with the date and nature of any changes of these, should be recorded. Finally the date, cause of death, and any further notes as to age should be entered. With such a system, in course of time, very exact conclusions could be obtained as to the viability and longevity of different kinds of animals, and as to the effect of the modes of keeping them in captivity.

(2) Following Ray Lankester, I distinguish between potential

longevity *, the limit of age which an individual could attain in the most favourable circumstances, and average or specific longevity, the average age to which the animals of a species attain under the natural conditions to which the species has become adapted. The difference between these two, I suggest is a measure of the severity of the conditions to which the species is subjected. In the case of the vast majority of animals it is impossible to get information as to either average or potential longevity. What information we have, is derived chiefly from knowledge of animals in captivity, and in this memoir I have been able to set down further information about species which have already been discussed by J. H. Gurney, Metchnikoff, Brehm and others, and to add information regarding many species about which nothing has been recorded hitherto.

(3) I apply the principle of comparison between average and potential longevities to the case of animals in captivity, by discussing the meaning of average duration and maximum duration. I suggest that a measure of the effect of the conditions to which animals are subjected in captivity may be obtained by comparison of the maximum duration with what may be known from other sources of the potential longevity, and by comparison of the average duration with the maximum duration. If the individual facts were collected in such a fashion as I have suggested in paragraph 1 of this general summary, I think the new method would lead to incontrovertible results, but even with the facts at my disposal, conclusions of fair validity can be drawn. It is necessary to note, however, that the figures of individual duration could be used to reveal more, if they were plotted out in curves instead of being used to give an arithmetical mean. The grouping of the individual cases with regard to the mean is of great practical importance. In some cases, for instance, I have pointed out that the majority of the cases were grouped towards the two extremes, that the individuals for the most part either

---

* [Lankester (*t. c.* p. 27) pointed out that some organisms, such as fish, molluscs, large crustacea, sea-corals, and many trees, appear to have no fixed potential longevity but to persist until they perish from disease, or are overwhelmed by some accident, whilst others, such as man, appear to have a set period to the possible duration of their lives. The mammals and birds with which I am concerned in this memoir belong to the second category. But I doubt if there be a fundamental distinction between the categories. First, as Lankester stated, the individuality of an organism like a tree, or a colonial invertebrate, differs from that of most organisms, and must be separately considered from the point of view of potential longevity. Next, certain organisms, such as many fish, appear to have more indefinite limits of growth (possibly related to mechanical factors, of similar importance in the case of aquatic mammals such as the Cetacea) than the majority of animals, the adult dimensions of which vary within narrow limits; definite or indefinite potential longevity may be related with definite or indefinite growth. (See also H. Spencer, 'Principles of Biology,' revised edition, 1898, vol. i. p. 135). I am more inclined to suppose that potential longevity varies with structure in the widest sense, including under the term structure the consequences of wear and tear, and auto-poisoning from the slow accumulation of waste-products. All pieces of machinery, from a motor-car to a cork-screw, have a potential longevity, dependent in the main on their structure, and apart from the quality of their manufacture, varying fairly closely with their complexity. Although our attention is arrested by extreme cases, these are only terms in a series.]

died in the first few months after arrival (by birth or otherwise) or survived to an age approaching the maximum, whilst in other cases there was a mortality rate steadily increasing with the length of residence in captivity. Obviously, the different curves that would be displayed by different animals, if the individual cases were plotted out in such a fashion, would give valuable information as to the special periods of danger in the case of different animals, and inform us if there were cases where the mortality was the result of progressive and cumulative effects of captivity. As, however, the facts at my disposal did not include any information as to the age or condition of the animals on reception, I came to the conclusion that it would be a waste of time to plot out curves.

(4) Unfortunately, collections of animals have to be considered from the financial point of view. The money value of an animal to a collection, that is to say, the price which can be judiciously paid for it, depends on its rarity, its attractiveness to the popular and scientific clients of the institution, and on the length of time it may be expected to live. A gorilla, for instance, is rarer and much more attractive than a chimpanzee, but as a gorilla has a very much worse expectation of life in captivity than a chimpanzee, its money value may be smaller. The facts that I have brought together form, so far as I know, the first beginning of a practical guide to the value of animals considered from this point of view.

(5) I have been able to bring together a large series of facts with regard to the relation between size and longevity. Taken in the broadest way, it is true that large animals may be expected to live longer than small animals, and in the case of very closely allied creatures the relation is frequently close. This may be associated partly with the effects of the accumulation of waste products. The cubical capacity of an animal increases much more rapidly than its linear dimensions, and of two animals of similar structure and constitution, the larger may take longer to be poisoned by its own waste products. Of course many simpler factors are involved—such as the greater resistance of a more bulky animal to rapid changes in the temperature of the air or water in which it lives. On the other hand, difference in longevity is not in exact proportion to size, and other constitutional factors are more important. Birds, for instance, in proportion to size, have higher potential longevities than mammals; whilst within the classes, orders, and even families, there are many cases where difference in size is overborne by other constitutional differences. It seems to be the case that, in proportion to their size, the more highly developed members of a group are able to live longer than their lower kin. There are also a very large number of cases, where increased viability and longevity are associated, as Metchnikoff suggested, with a relatively low capacity of the hind-gut.

(6) It has long been known to aviculturists that common

British birds are often very difficult to keep in captivity. I have shown that this difficulty occurs in so large a number of different kinds of British birds and mammals, that it may be laid down as a curious principle (to which naturally some exceptions exist) that British birds and mammals have a lower viability in captivity in England than their immediate allies from any other part of the world. This remarkable circumstance is in the first place, in the strict sense of the word, accidental, and finds partial explanation in a cause independent of the constitution of the animals. Most captured examples of wild species either are weakly individuals, or are injured or frightened by the process of capture: a heavy mortality is to be expected. In the case of animals that come from a distance, much of the heavy mortality takes place before arrival or, because of the additional evil effects of the conditions during transit, and the survivors which reach their destination are relatively strong and hardy. On the other hand, local animals reach their destination in a shorter time, and the heavy mortality takes place inside the Gardens. But this explanation is not wholly sufficient to cover the cases, and I think it may be assumed that wild birds and mammals in Britain have acquired an intolerance of man, without which, unfortunately, they would not have been allowed to maintain their existence. This psychological acquisition presses heavily on them in captivity. It appears to be the case that an opposite process of selection is taking place in the parks of great cities, and that wild birds in particular are learning not to fear man. It would be interesting to know if wild birds taken in a London park lived better in captivity than birds of the same species from country districts.

(7) The climate from which a bird or mammal comes has the smallest possible relation to its viability in captivity. A. Heilprin (*Distribution of Animals*, Int. Sci. Series, vol. lviii., 1887, p. 35) pointed out the error of the common belief as to climate being the principal factor that regulates or controls the distribution of animals. Amongst mammals and birds a vast majority of species and genera regarded as tropical have an actual or recent range into temperate or even frigid climates. Of those now limited to the tropics, still fewer are accustomed to a steady temperature. Some range periodically or occasionally to altitudes where great cold occurs; others, by exposure to the intense radiation of the dry air of plains at night, regularly endure cold going down to freezing-point; whilst many inhabitants of tropical forests (which we naturally associate with steamy heat) must be subjected to great cold in their nocturnal wanderings on the summits of tall trees. The abundance of thick hair and fur and of close feathering amongst tropical creatures is a clear indication that their life is not spent basking in tropical sunlight. Mammals and birds have the power of maintaining their internal temperature at a normal that varies only within an extremely narrow range, notwithstanding the temperature changes in their environment; and I do not doubt, not only that they can endure considerable

cold, but that even rapid and considerable changes of temperature are a necessary stimulus to their viability.

On the other hand, there are cases where the change to the climate of London is certainly trying, but these occur not amongst tropical but temperate or arctic animals. The production of a thick coat against the onset of winter cold, and its doffing when summer approaches, appear not to be direct reactions to temperature but organic rhythms adapted to the seasons in the natural habitat of the animals. Thus animals from the far North, accustomed to the short arctic summer, retain their thick coats in this climate long after their possession is cumbersome. Still worse is the case of animals brought from South temperate zones, which begin to moult their thick coats when our winter, their summer, approaches. I have not information as to how soon if ever these rhythms readjust themselves to the reversed conditions. It is clear, on the other hand, that part at least of the mechanism by which coats become warmer, is direct stimulation from the surrounding temperature, and such different creatures as Carnivora and Baboons rapidly get better coats when exposed to the open air. The seasonal rhythms connected with breeding are also a cause of mortality to young or adults, when the conditions of climate are reversed. Birds from the Southern hemisphere, if they survive, appear to readjust themselves in this respect; it is more doubtful if mammals do so.

(8) The idea that it is a fundamental necessity to protect healthy adult mammals and birds from cold by providing them with artificial heat is fallacious. The supreme necessity is free access to open air. In most cases this should be combined with shelter from rain and wind, and in some cases the shelter should be supplied with artificial heat—perhaps often even in excess of what is now customary—but only so far as it can be arranged without any detriment to fresh air. I think this is probably specially important in the case of nocturnal animals; as we are accustomed to see these asleep all day in the warmest corner given them, we are disposed to forget that at night they move about actively often in great cold.

For all mammals and birds steady exposure to an even temperature is unnatural and unhealthy; change is a necessary stimulus, and permanent existence indoors is the worst possible condition for viability and longevity.*

---

* [When this memoir was read my friend Dr. Leiper called my attention to the undoubted fact that the problem of the duration of life of animals in captivity is complicated by the effects of parasites. In the course of my paper (see pp. 470 and 540) I have made reference to this subject, pointing out that some of the evil caused by confinement in warmed houses is undoubtedly not the direct result of absence of fresh air, or of artificial heat, but comes about mediately inasmuch as the conditions are specially favourable to parasites. It is true of course that any argument as to the potential longevity of animals based on maximum durations in captivity is subject to the effects of parasitism. I hope that the work of Mr. Plimmer, Mr. Beddard, Dr. Leiper, Dr. Nicoll, and Mr. Coventry, who are now systematically examining the parasites at the Gardens, will before long enable us to eliminate some at least of these evils.]

(9) The tabulation and analysis of the records in this memoir has been a laborious task which has not been lightened by the knowledge that the materials were imperfect. But I trust that it may be a step towards obtaining systematic and more exact knowledge on the subject. Such knowledge is the only sure basis for that improvement in the condition of animals in captivity which those in control of Zoological Collections desire to bring about. The peculiarity by which a menagerie is distinguished from a museum is that its zoological specimens are alive. Not the obtaining of rare animals, nor the addition to the records of "species new to the Collection" should be the chief glory of a Zoological Society, but that Collection should be judged most valuable and successful in which the average duration of life of its inhabitants approaches potential duration most closely.

Note on the Theory of Longevity.

With three notable exceptions, those of Lankester, Weismann, and Metchnikoff, discussions of the theory of longevity may be dismissed briefly here, partly because they have been treated fully in the literature of the subject*, and partly because they do not pretend to explain why the gift of life has been measured out to different animals in unequal portions. Bacon made a careful summary of the known facts, but refrained from general conclusions. "In tame creatures" he wrote, as cited by Lankester from Basil Montagu's translation, "their degenerate life corrupteth them, in wild creatures their exposing to all weathers often intercepteth them; neither do those things which may seem concomitants give any furtherance to this information (the greatness of their bodies, their time of bearing in the womb, the number of their young ones, the time of their growth, and the rest), in regard that these things are intermixed, and sometimes they concur, sometimes they sever." Buffon thought that there was a relation between the total duration of life and the period of growth, and set down the ratio between the two as 6 or 7 to 1. Flourens followed Buffon's idea, but took as the limit of growth, the age at which the long bones unite with their epiphyses, estimating that the ratio of the longevity to the period of growth was as 5 to 1. Bunge, without calculating an exact ratio, pointed out that there was a frequent relation between the longevity and the time taken by a new born animal to double its weight. Such calculations at the best are limited in their application to the higher animals, and even amongst these have to encounter many exceptions; so far as they go they must be taken as secondary and comparatively accidental correlations.

Ray Lankester's early contribution (*t. c.* p. 71) was a serious addition to knowledge. Having distinguished between potential and average specific longevities, and shown that the latter were determined to a large extent by accidents outside the constitution of the species (destruction by enemies, diseases and so forth), he attributed the former to constitutional causes of which the most important were the degrees of evolution or individuation and the amounts of personal and generative expenditure. High individuation, and low expenditure were to be associated with great potential longevity.

---

* See specially E. Ray Lankester, *t. c.*; E. Metchnikoff, *t. c.* p. 39, and article *Longevity*, in the XI. edition of the Encyclopedia Britannica.

A. Weismann, in his famous essay *Ueber das Dauer des Lebens* (translated in Essays upon Heredity, Oxford 1889), examined the various constitutional explanations of the duration of life. He admitted that small animals might be expected to run through the cycle of life more rapidly than large animals; that if the period of growth were long it might expand the total duration of life; that creatures in which the metabolic processes were extremely active, might finish their career more quickly (as Lotze suggested in his *Microcosmus*) than slow-living creatures; that the rates of personal and of reproductive expenditure had some influence. But he urged that the application of these various principles was only partial and led to so many inconsistencies that no constant correlation could be established. He came to the conclusion that duration of life was really dependent upon adaptation to external conditions, that its length was governed by the needs of the species and was regulated by the same process as that by which the structure and the other functions of an organism were adapted to the environment.

In adaptation to the environment, Weismann urged, it is the prosperity of the species and not that of the individual that is concerned. That species is most successful which contains at any time the largest number of vigorous adults, and as every organism in the vicissitudes of life becomes to a certain extent worn and dilapidated, it is not to the advantage of the species that individuals should live too long. As soon as the business of reproduction has been successfully accomplished, the advantage of an individual to the species is gone, and the sooner it disappears the better. Animals are in fact wound up to go for the requisite time, and no longer. The mechanism Weismann suggested was a limitation of the possible number of cell generations, admitting that this was hypothetical. The requisite length of time was determined by the reproductive habits of the animals. Slow breeding, for instance the production of a small number at a birth or in a season, long brood-care either embryonic or post-embryonic, and all the various circumstances by which an organism or pair of organisms require longer time to replace themselves by their younger and fresher children, stretched out the duration of life; whilst rapid reproduction, absence of brood-care and so forth, contracted it. By the process of natural selection the incidence of death was adapted to the needs of the species.

Obviously where there was a heavy incidence of death on the young, a longer life would be required to secure replacement of the parent by successfully reared young.

Weismann (*t. c.* p. 11) brought together a very remarkable and cogent series of cases showing that a constant correlation existed between the reproductive powers and the duration of life of the individuals of a species, and his theory has an extremely important place in the history of the subject. It is to be noted, however, that although he appreciated the probability that a very large number of deaths were due to external causes (enemies, diseases, accidents, untoward conditions) he did not explicitly work out the important relation to his theory of Lankester's distinction between average specific longevity and potential longevity. It is clear that if the duration of life be fixed by some internal cause such as the limitation of cell-reproduction, it must be the potential longevity and not the average specific longevity that is affected; but if the majority of animals perish from accidents from without, it is difficult to see how their potential longevity could be influenced by selection.

Metchnikoff's most interesting work has still further increased the difficulty in the way of accepting Weismann's theory. Metchnikoff investigated the causes of death in a very large number of cases, including those of insects which die very soon after having laid their eggs, and came to the conclusion that it is extremely doubtful if natural death occurs except in the rarest possible cases. Most animals perish long before they have reached an age at all approaching what may be regarded as their potential longevity. In the cases that survive the accidents of youth or early maturity, another series of accidents take effect. The changes of senility are induced from without; the various degenerations are brought into existence by the absorption into the system of various kinds of poisons, and these whether they are due to the exudations of the microbes of intestinal putrefaction, or to those of special diseases, are entirely external to the constitution. Senile animals perish because they can no longer resist common diseases or common accidents. It would be only in a world where the most perfect hygiene reigned, and from which the bacteria and microbes of diseases had been driven, that the majority of the members of a species would attain the potential age, and that death would come on them from purely constitutional causes. And so the conception of the duration of animal life being an adaptation to breeding habits, produced by the operation of selection, disappears.

I cannot doubt but that the average specific longevity is the dominating factor in animal life. At every stage of their existence animals are assaulted from without by enemies, diseases, and their whole environment. To say that is merely to restate the existence of the struggle for existence, the fundamental proposition of the theory of natural selection. If favourable variations arise, that is to say changes in diathesis, structure, function or habit, which enable the possessors of these to make a better fight against enemies, or diseases, or any part of their hostile environment, then we expect such variations to be preserved, and, consequently, the constitution of the organism to be modified in the direction of adaptation to its environment. It is no part of my present argument to discuss whether such variations appear in response to the environment, or by large or small stages; these are wide questions not germane to the present issue. But they do arise, and in such a fashion there have come about increases or decreases in size, advances in structure or degenerations, protective colours and weapons—the whole armoury offered by variation to the choice of natural selection. Such improved powers of resistance to the environment may increase the average specific longevity, and indirectly may affect the potential longevity. But the attainment of the latter is too rare an event to come under the direct control of natural selection.

There is no more important part of the structure and function of an organism than that associated with reproduction. The impulses and instincts connected with fertilization, the time, duration and frequency of rutting, the numbers of ova that are fertilized and allowed to develope, the duration of embryonic development, the amount and character of post-natal brood-care, the whole apparatus and machinery of the reproductive process, present an extraordinary series of modifications from species to species, and from individual to individual. They are subject to much variation amongst individuals at the present time, and it may well be presumed that they have offered a rich material to natural selection in the past. Weismann has established a correlation between longevity and reproduction, but I think his interpretation of the correlation must be reversed. It is not longevity that has become adapted to reproduction, but the rate of reproduction has been adapted not to potential longevity, but to average specific longevity. Average specific longevity is simply a measure of the pressure of conditions on a species, and its constitution, including its mode of reproduction, has been shaped in conformity with the pressure of these conditions. Potential longevity is a bye-product of the process; it depends directly on the constitution, and is simply the result of the fact that if the constitution be adapted to meet the average mortality, it must be able to outlive, and will outlive, the average duration of life in a number of fortunate cases.